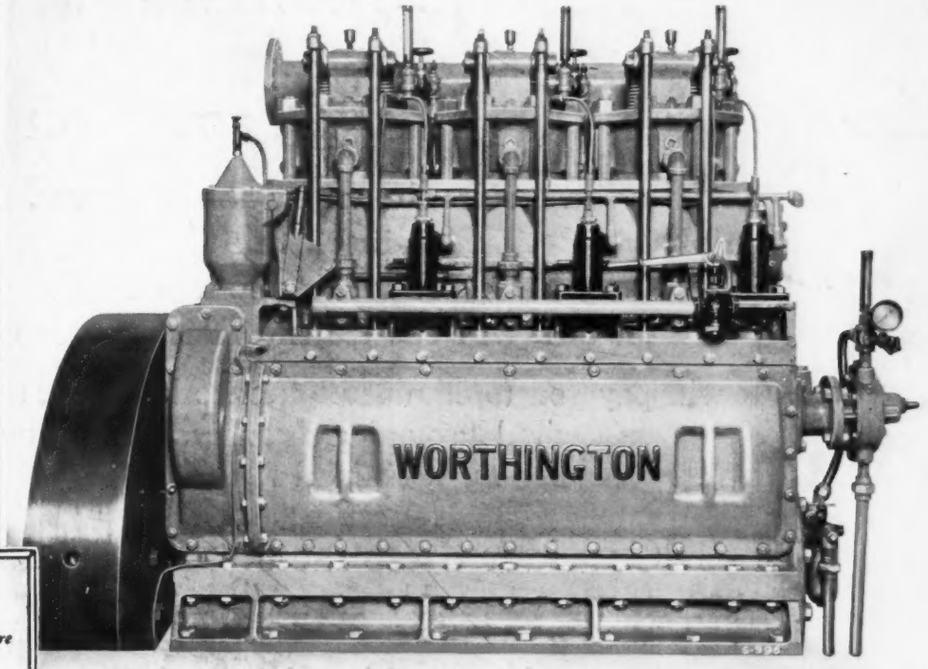
ngineering
Library

MAR 16 1931

ELECTRICAL WORLD

MARCH 14, 1931
McGraw-Hill Publishing Company, Inc.
25 cents per copy



PUMPS
All Sizes... All Types
For All Services
Any Capacity... Any Pressure
COMPRESSORS
Stationary and Portable
CONDENSERS
and Auxiliaries
DIESEL ENGINES
GAS ENGINES
FEEDWATER HEATERS
WATER, OIL and GASOLINE METERS
MULTI-V-DRIVES
ROCK DRILLS
AUTOMATIC HEAT TREATING MACHINES FOR DRILL STEEL
FORGING FURNACES FOR DRILL STEEL
DRILL STEEL
ACCESSORIES
CHROMIUM PLATING
Literature on request

There is a decided need for this
Modern Diesel Engine

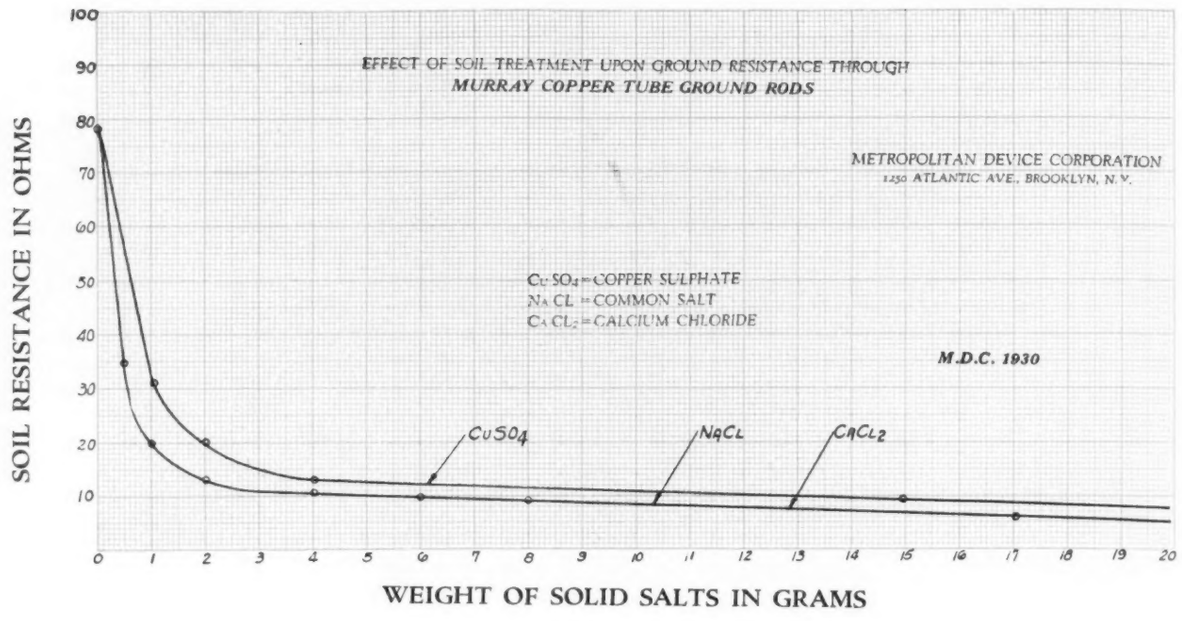
A relatively small companion to the large Worthington Diesels, this engine meets a real need in many industries.

For small municipal power plants; industrial plants; airports; water works; miscellaneous pump, compressor and other industrial drives; and night or peak loads in large power plants . . . it is capable of heavy duty in continuous service. This is a four-cycle direct-injection engine, built in 2, 3, 4, 5 and 6 cylinder sizes, 50 hp. to 150 hp. *Write for Bulletin S-500-B5.*

WORTHINGTON PUMP AND MACHINERY CORPORATION
Works: Harrison, N. J. Cincinnati, Ohio Buffalo, N. Y. Holyoke, Mass.
Executive Offices: 2 Park Avenue, New York, N. Y.
GENERAL OFFICES: HARRISON, N. J.
District Sales Offices and Representatives.
ATLANTA CHICAGO DALLAS EL PASO LOS ANGELES PHILADELPHIA ST. PAUL SEATTLE
BOSTON CINCINNATI DENVER HOUSTON NEW ORLEANS PITTSBURGH SALT LAKE CITY TULSA
BUFFALO CLEVELAND DETROIT KANSAS CITY NEW YORK ST. LOUIS SAN FRANCISCO WASHINGTON
Branch Offices or Representatives in Principal Cities of all Foreign Countries

ED-35

WORTHINGTON



Know your grounds—Protection demands it

Murray Copper Tube Ground Rod

Based upon results shown by above curves, 1½ lbs. of copper sulphate solution having 2 to 5% strength, and according to field conditions, will treat a sphere in the ground 10 feet in diameter and will reduce the resistance from 80 to 15 ohms.

It will pay you to eliminate guesswork and use a positive method for obtaining desired ground resistances. This you can do with the Murray Copper Tube Ground Rod.

Consider these facts:

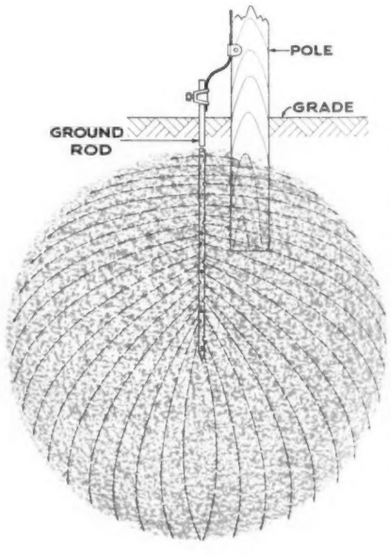
—ground resistance variations can be regulated,—whether due to drought or soil conditions.

—direct treatment of the ground is provided,—treating solution is simply poured into the tube,—no preparation of soil external to rod required.

—the copper tubing alone remains in the ground,—the result is a rust-proof, corrosion-proof, long life ground.

—they are easily driven,—the driving rod is used with pile driver effect.

—but one driving rod is needed for every fifty rods, transportation charges are small based on practically copper tubing only.



8 page booklet on request

METROPOLITAN DEVICE CORPORATION
1250 ATLANTIC AVE., BROOKLYN, N. Y.

ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

L. W. W. MORROW, *Editor*

ALLEN M. PERRY, *Managing Editor*
EARL WHITEHORNE, *Contributing Editor*
G. F. WITTIG, *Statistical Editor*
H. M. CAMERON, *Associate Editor*
A. E. KNOWLTON, *Associate Editor*
F. C. WELLS, *News Editor*
E. R. SEARLES, *Assistant Editor*

FRANK R. INNES, *Western Editor, 520 N. Michigan Ave., Chicago*
H. S. KNOWLTON, *New England Editor, 1427 Statler Bldg., Boston*
WALTER C. HESTON, *Pacific Coast Editor, 883 Mission St., San Francisco*
PAUL WOOTON, *Washington Correspondent, National Press Bldg., Washington*

JAMES H. RUDD, *Publishing Director*

Trading room Chicago Board of Trade

Ewing Galloway

MARCH 14, 1931

Contents Copyrighted, 1931, by McGraw-Hill Publishing Company, Inc.

VOLUME 97 . . . NUMBER 11

D. C. Transmission—
a bright promise for the future 488

Network Promises Marked Economies 492
By D. K. BLAKE, *General Electric Company*

Pittsburgh Primary Network Saves 40 per Cent . 496

4-Kv. Network Saves 20 per Cent 500
By A. H. SWEETNAM, *Edison Electric Illuminating Company of Boston*

Ashtabula Station—
Cleveland's newest generating center 504

International Capital
in Europe's Electric Utilities 508
By EMIL L. JORDAN, *formerly economist International Public Service Corporation*

News of the Industry 477

Editorials 485

Dairy Uses 60 Watts per Quart . 491

Electrically Heated Plot
Doubles Garden Yield 499

Allowable Fiber Stresses of
Wood Poles Under Loading . . . 503

High-Intensity Lighting Systems
for the Work-World 510

Readers' Forum 510

Men of the Industry 511

Financial and Statistical 513

Business Conditions 516

New Equipment Available 520

McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., New York, N. Y.

JAMES H. MCGRAW, Chairman of the Board
MALCOLM MUIR, President
JAMES H. MCGRAW, JR., Vice-Pres. and Treas.
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
HAROLD W. MCGRAW, Vice-President
H. C. PARMELEE, Editorial Director
C. H. THOMPSON, Secretary

CABLE ADDRESS: *"Machinist, N. Y."*

Published weekly. $5 per year. 25 cents per copy. Entered as second-class matter, January 20, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Member A.B.C.
Member A.B.P.

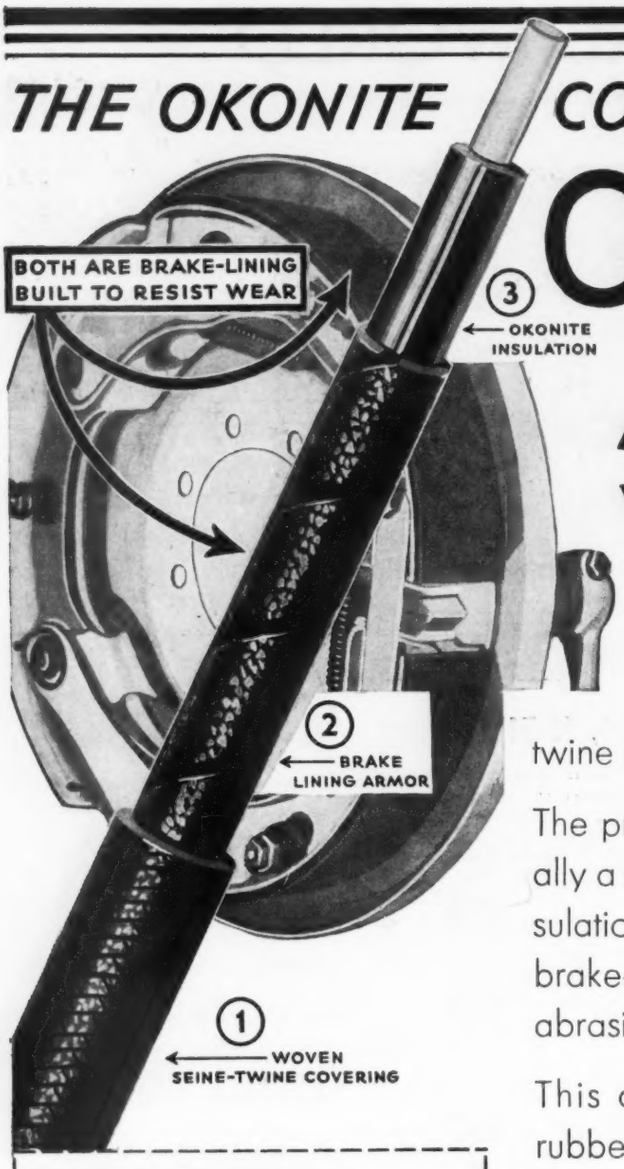
NUMBER OF COPIES PRINTED THIS ISSUE, 18,250

NEW YORK District Office, 285 Madison Avenue
WASHINGTON, National Press Building
CHICAGO, 520 N. Michigan Avenue
PHILADELPHIA, 1600 Arch Street
CLEVELAND, 501 Guardian Building
ST. LOUIS, 1556 Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
BOSTON, 1427 Statler Building
GREENVILLE, S. C., 1301 Woodside Building
DETROIT, 2-257 General Motors Building
LOS ANGELES, 632 Chamber of Commerce Bldg.
LONDON, 6 Bouverie Street, London, E. C. 4

THE OKONITE COMPANY ANNOUNCES

OKOLAST

(IT LASTS)



A Tree Wire Armored with Brake-Lining . . .

The abrasion-resistant outside covering (1) of OKOLAST is a very tough impregnated fabric of specially treated seine twine and is proof against the elements.

The protective armor (2) of OKOLAST is actually a special brake lining wrapped over the insulation to protect it from wear. Like automobile brake-lining it is made to stand almost endless abrasion.

This combination added to the OKONITE rubber insulation (3) gives a three-fold protection against the severe service to which tree wire is subjected.

Filling out and mailing the coupon at the left will bring you a sample of this super tree wire and descriptive bulletin.

THE OKONITE COMPANY
PASSAIC, N. J.

Gentlemen:

I want to see how brake-lining is applied to your OKOLAST TREE WIRE to protect it from wear. Kindly send me a sample cut back to show how it is made.

Name _____

Department _____

Company _____

Address _____
No. and Street City State

E. WORLD 3-14-31

THE OKONITE COMPANY
Founded 1878
THE OKONITE-CALLENDER CABLE COMPANY, INC.
Factories: Passaic, N. J. Paterson, N. J.
SALES OFFICES:
NEW YORK CHICAGO PHILADELPHIA PITTSBURGH ST. LOUIS BOSTON
ATLANTA BIRMINGHAM SAN FRANCISCO LOS ANGELES SEATTLE DALLAS
Novelty Electric Co., Philadelphia, Pa. F. D. Lawrence Electric Co., Cincinnati, O
Canadian Representatives: Engineering Materials, Limited, Montreal
Cuban Representatives: Victor G. Mendoza Co., Havana

ELECTRICAL WORLD

for the Week Ending

March 14, 1931

Wide World Photos

Although not appearing on the balance sheet, the greatest asset of the Bell System is the skill, energy and character of the hundreds of thousands of men and women who make up its organization, who have during the past year rendered a more efficient service than ever before.

WALTER S. GIFFORD,
President,
American Telephone &
Telegraph Company.

Oregon gets a one-man commission

—**Oregon reforms its regulation** of public utilities, bids farewell to its public service commission and appoints a single commissioner with special mandate to back up consumer and public interests as election aftermath—*p. 481.*

—**Seattle loses superintendent** of municipal light department as Mayor "fires" J. D. Ross, one of country's most capable municipal engineers, for alleged inefficiency, extravagance and failure to cooperate—*p. 478.*

Comerford explains stock "write-up"

—**New England group write-up** of $17,412,290 charged by Federal Trade examiner, explained by President Comerford as additional value due to natural enhancement and undistributed profits—*p. 479.*

—**Electric utilities in Europe** expand as international capital speeds development of resources and markets. Holding companies of European rather than American style involved—*p. 508.*

Networks promise marked economies

—**Network trend is under way.** Through mass production and standardization marked economies are promised. Boston and Pittsburgh, adopting this plan, show savings of 20 and 40 per cent respectively in 4-kv. systems—*pp. 492, 496, 500.*

—**Power practice revolution?** Engineers developing vacuum tubes of three-element, mercury and hot-cathode types foresee many changes as imminent in transmission, interconnection, underground and industrial engineering. In developmental stage—*p. 488.*

—**New York State link assured** as transmission tie for New York Edison and Niagara-Hudson is agreed upon. Work to start at once on construction to bring financial-engineering unity under F. L. Carlisle—*p. 478.*

—**Cleveland's newest station,** Ashtabula, closely follows design of Avon. Here 50,000-kw. instead of 35,000-kw. generating units have been used and refinements in earlier engineering incorporated to advantage—*p. 504.*

Metropolitan New York-Upstate Interconnection Becomes Adopted Plan

RIPENING of long-mooted plans to interconnect the Niagara-Hudson and New York City transmission systems led this week to authoritative announcement that this policy is now definitely accepted by the two great systems and will reach the stage of construction when the necessary preliminary steps concerning the acquisition of right-of-way and other details shall have been accomplished.

The Niagara-Hudson is to build a 110-kv. line from the Greenbush substation, south of Albany, to Poughkeepsie, where it will connect with a 132-kv. line running to the Dunwoodie substation of the Edison system in Yonkers. A line already runs from Greenbush to Poughkeepsie, but its voltage is only 66,000. Two 132-kv. lines already link the Dunwoodie substation with the main power plants of the Edison system, and the Greenbush substation also is connected with lines stretching from Niagara Falls to the Massachusetts state line.

The total distance between the Greenbush and Dunwoodie substations is 110 miles. Existing interconnections with Connecticut and New Jersey-Pennsylvania power companies at Poughkeepsie, where, it is understood, the Niagara-Hudson will build an important substation, will, it is predicted, be increased, giving the plans for extension an interstate scope.

The Greenbush substation is near the eastern end of a state-wide system of high-tension lines stretching from Niagara Falls to the water-power sites in the Upper Hudson Valley. At some points five transmission lines run almost abreast. This network connects at Syracuse and Utica with another network stretching west of the Adirondacks to the St. Lawrence River and at Buffalo with a network running south to the Pennsylvania border.

The group of transmission lines described is linked with the Associated Gas & Electric properties in central New York and adjacent states, and with other power systems in Pennsylvania, New Jersey and New England.

▼

Seattle's Mayor "Fires" Superintendent Ross

A SENSATION WAS CAUSED in political and power circles in Seattle on Monday of this week by the news that Superintendent J. D. Ross of the municipal lighting department had been summarily discharged by the Mayor of the city, Frank Edwards. Mayor Edwards alleged as the reason for this action that Mr. Ross had been inefficient, disloyal to the city's best interests, extravagant and wasteful in the use of public funds and had failed to co-operate with the Board of Public Works, the City Council and the city's executive head. The Mayor subsequently named A. F. Marion, chief engineer Pacific Coast Company, to succeed Mr. Ross, but this appointment must be approved by a two-thirds vote in the Council before becoming effective.

The Mayor's action was taken on the eve of a city election, held on Tuesday, in which the dominant issue was an amendment, sponsored by Superintendent Ross and opposed by the Mayor, to permit the city light department to set up and maintain its own engineering department. This amendment carried by 27,890 to 25,911, and the entire Council slate opposing Ross was defeated. As a result talk of a recall of the Mayor is heard.

Mr. Ross, who enjoys well-earned prominence among municipal-plant executives and engineers, had been with the department, of which he is regarded as the founder, for 26 years. He denies the Mayor's allegations and says that his summary discharge was an outcome of the political situation.

▼

F. D. Comerford's View of New England "Write-up"

TESTIMONY GIVEN on March 6 by R. E. Barnes before the Federal Trade Commission, for which he is an examiner-accountant, in the course of the commission's inquiry into the financial set-up of the New England Power Association, included a statement to the effect that when the association was formed in 1926 it acquired common stocks valued on the books of the New England Company, predecessor holding company, at $14,554,800. This value, Mr. Barnes testified, "was immediately written-up to $31,967,090, or a net write-up of $17,412,290 in value of securities."

In a statement to newspaper reporters, Frank D. Comerford, president of the New England Power Association, commented on Mr. Barnes' characterization of the figure difference as a

▼ ▼ ▼

"ELECTRIC EYES" FOR NORTH POLE SUBMARINE

Left to right—S. G. Hibben, manager commercial engineering department, Westinghouse Lamp Company; Captain Danenhower and Chief Engineer Gallagher of the *Nautilus*; E. W. Beggs, Westinghouse underwater-lighting specialist; Commander Wilkins.

Five-thousand-watt lamps like that shown will guide Sir Hubert Wilkins in the submarine Nautilus *through polar waters next summer. The lamps withstand a pressure of 100 lb. per square inch (equivalent to underwater pressure at 200 ft. depth), produce about 1,000,000 cp. and project a 100-ft. beam.*

"write-up." Mr. Comerford's statement was as follows:

The stockholders of the old New England Company, which held properties and shares of other companies, sold these assets to a new group, including New York interests, Stone & Webster and others, for a price in excess of the value carried on the books of the old company. The additional value placed on these assets by the new owners represented largely a natural enhancement but partly reflected earnings left in the company over a long period of years and not declared out in dividends. The books of the old company largely represented values determined fifteen or twenty years ago. The new owners, after careful examination by engineers and other experts, invested $20,500,000 cash in the new company which was used for expansion purposes.

At a later hearing Mr. Barnes traced the transactions which led to the control of two Rhode Island public utilities by the New England Power Association, testifying that there was a "write-up" of $20,469,857 during transfer of assets of the Narragansett Electric Lighting Company from one holding company to another until they finally rested in 1927 with the Narragansett Electric Company, New England Power Association subsidiary.

Carl S. Herrmann, treasurer of the association, issued a statement in reply. "The properties were purchased by the United Electric Power Company," he said. "Values of the property so purchased, as set up on the books of the purchasing company, were based on appraisals by Messrs. Jackson & Moreland of Boston for the company and by Messrs. Sloan & Cook of Chicago for the Rhode Island Public Utilities Commission. The commission fixed the value of the assets in authorizing the issue of securities by the new purchasing company, after a public hearing, all of which appears in a certified copy of the order which is in the records of the Federal Trade Commission."

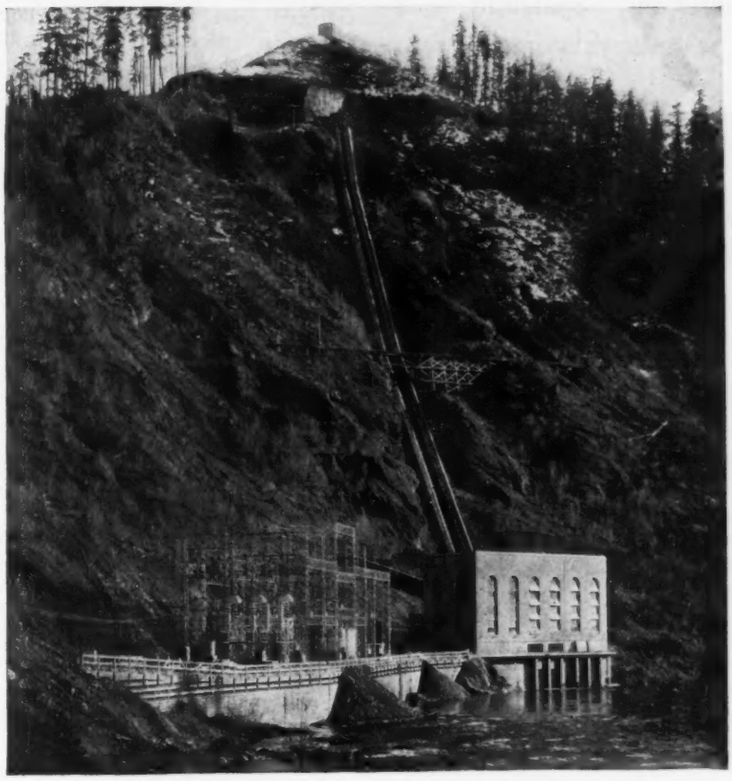
▼

Oklahoma Men for Public Information Campaign

A TWO-DAY CONVENTION of the Oklahoma Utilities Association on Tuesday and Wednesday passed resolutions favoring the appointment of a public policy committee and the proposed public information campaign recommended by the public relations division of the association. Prominent national and local utility executives spoke at the sessions.

Officers elected were: President, S. I. McElhoes, Oklahoma City, vice-president Southwestern Light & Power Company; first vice-president, R. J. Benzel, Oklahoma City; second vice-president, H. L. Montgomery, Bartlesville; treasurer, R. Emerson, Oklahoma City (re-elected); manager, E. F. McKay, Oklahoma City (re-elected).

ANOTHER HIGH-HEAD TURBINE FOR OAK GROVE



No. 2 unit in the Portland General Electric Company's Oak Grove plant, on the Clackamas River, has begun regular operation. It comprises the right-hand addition to the power house and the right-hand penstock. A second 30,000-kva. G.E. generator and 40,000-hp. Pelton reaction turbine were added. Operating head is 849 ft.

▼ ▼ ▼

Power Systems Unharmed by Widespread Storm

DESPITE WEATHER BUREAU reports of a relatively severe storm of wind, rain and snow (separately or combined) stretching northeast from Missouri to the Atlantic Coast, ELECTRICAL WORLD inquiries throughout the storm path have been met by the statement that injury to electrical systems was virtually non-existent or trivial and that rapid resumption of service in the few cases of interruption involved no unusual problems and entailed no extraordinary exertion.

Such reports have been received from the New England Power Association, the Buffalo, Niagara & Eastern Power Corporation, the Public Service Electric & Gas Company (New Jersey), the Philadelphia Electric Company, the Consolidated Gas, Electric Light & Power Company (Baltimore), the Public Service Company of Northern Illinois, the Iowa Power & Light Company, the Milwaukee Electric Railway & Light Company, the Cleveland Electric Illuminating Company, the Consumers Power Company and the Tennessee Electric Power Company. The Consumers Power reports normal operation in the lower Michigan peninsula, with four to sixteen inches of snow and fairly high winds but no sleet.

Falling trees and heavy snow interrupted distribution in the Rutland district of the Central Vermont Public Service Corporation on Sunday night, 300 services being affected and 150 poles going down. One-third of the load at Rutland was lost, but interconnection prevented the city from being at any time without electricity and nearly all the circuits were in order by Tuesday night. Little interruption took place on the system of the Public Service Company of New Hampshire.

Transmission lines as a whole stood up against the storm; but it was again made manifest that the operating departments, philosophically inured to battle with the elements year in and year out, take the maintenance of service, whatever the weather conditions, as all in the day's work.

In cities along the seaboard subjected to unusual tides or where the rainfall was abnormal subway transformers proved great trouble averters, obviating damage from the filling of manholes.

Power and Regulation in State Legislatures

ALABAMA. — Electric utilities in Alabama will be subjected to an examination of their valuations for rate-making and tax-paying purposes and their stock issues under a joint resolution passed by the two houses of the Legislature. A special committee for this purpose was set up by a vote of 69 to 4 in the House and a unanimous vote in the Senate. Appointment of the committee followed charges by legislators that there is a vast difference in the valuation of the Alabama Power Company for rate-making purposes and the valuation for tax-paying purposes.

ARKANSAS.—The proposed tax on electric power has aroused vigorous opposition in five counties which await the White River development, on which it is planned eventually to spend $43,000,000. Fear is expressed that passage of the law imposing the tax will bring the abandonment of the project.

IDAHO.—The regular legislative session is over, but Governor C. B. Ross immediately convened an extra session to which he sent a message on taxation urging among other things the levying of a special tax upon electrical energy generated from natural resources.

ILLINOIS.—Repeal of the law creating the Illinois Commerce Commission is sought in a bill introduced in the Legislature by Representative P. J. Breen. "It is time we went back to the old system of home rule over our utilities," he explained.

INDIANA.—The legislative session has ended by statutory limitation. The Senate bill designed to make state regulation of public utilities more stringent was killed in the House, the votes of 64 members of the Democratic majority being cast for indefinite postponement. This bill passed the Senate on January 28 with only three votes against it. A House bill requiring electric power companies to extend their service to residents along any public highway upon petition of 5 per cent of such residents if the petitioners would pay the cost was also killed by indefinite postponement. The bill imposing a tax on electric power of 0.25 cent a kilowatt-hour if the price were less than 2 cents and 2 cents a kilowatt-hour if more was another pigeonholed indefinitely. The Dennigan bill, which would prohibit public utilities from selling appliances and products not manufactured by them and which would restrict the utility companies of Indiana from buying materials and supplies from corporations in which their officers and directors are interested, passed the Senate by 26 to 18, but not the House.

KANSAS.—The bill conferring jurisdiction over public utility holding companies upon the Public Service Commission has now been passed by the House and sent to Governor Woodring for his approval. The measure provides that no foreign holding company shall acquire control of a local public utility without first agreeing to submit to the commission in the matter of rates and other transactions affecting the operating company. Management, engineering and similar contracts are made subject to the approval of the commission. The Senate has passed the bill already approved by the House prohibiting utilities from merchandising, and it has gone to the Governor.

MINNESOTA.—The Stockwell bill to permit municipal lighting plants to sell energy to adjacent communities received preliminary approval from the House on March 7. In the Senate a similar bill has been amended to require a five-eighths vote of citizens before extensions are made. The aim of these and other bills is to build up a network of connected municipal plants which at some future time could be taken over by the state through a fifty-million-dollar bond issue. A proposed constitutional amendment for submission next year would authorize the state to acquire and develop water-power resources, operate auxiliary steam plants and produce and distribute electricity to the general public and municipal plants anywhere.

MISSOURI.—The valuation of public utilities fixed by the Public Service Commission for rate-making purposes shall be used by the State Tax Commission as the basis for assessing the utilities for taxation purposes under a bill engrossed by the House. That body has also engrossed a bill to prohibit utilities selling appliances, even including electric light bulbs. A Senate bill would give the Public Service Commission authority to delve into the ultimate ownership of stock and to understand more thoroughly the intercorporate relationships of operating companies.

NEBRASKA.—Senator Wherry has renewed his effort for a law forbidding electric and gas companies from using more than one rate basis. He has combined two bills previously introduced, one of which had been killed, which permit the collection of a minimum charge and the sale of meters or other equipment to customers and performance of labor in installing equipment, but for each service performed there must be an exact charge. No penalty for delinquency, no service charge, no meter rental or other charge, toll or penalty may be added.

NEVADA.—A bill has been introduced to prohibit merchandising by a public utility. Exception is made of "such articles, commodities or appliances as may be necessary for use in the conducting of its business as a business utility," and provision is made that in towns having a population not exceeding 1,500 and in combined communities where the inhabitants do not exceed 5,000 the Public Service Commission may grant the right to engage in merchandising for a period not exceeding one year at a time.

NEW YORK.—Thomas F. Conway, former Lieutenant Governor, the minority member of the St. Lawrence Power Development Commission, has submitted a bill embodying his views to the Governor and the majority legislative leaders, who it is predicted will agree on the final form of the St. Lawrence bill and thus insure its speedy passage. Nine public utility bills emanating from the office of Governor Roosevelt were introduced on March 12. One of these bills deals with control of holding companies, another defines rate bases along "prudent investment" lines, and a third provides for the setting up of municipal utility districts, on voters' petition, to own, maintain and operate electric or gas plants, financed through bond issues. Establishment of such a district must be ratified at a public election.

OHIO.—"Public utilities should be taxed neither more nor less than other classes of property or business," the Ohio subcommittee on public utilities of the

AIRSHIPS SAFEGUARDED BY ELECTRICITY

—By Ewing Galloway, N. Y.

Landing and leaving of all airplanes at Glendale, Calif., is governed by colored electric signals controlled as shown.

taxation committee says in a recent report. "The present so-called excise tax upon the gross receipts of public utilities is a tax upon business and is excessive," the report declares. "It is a penalty tax upon both the management and the consumer and probably is the result of an erroneous theory that state regulation of rates and finances is inadequate and that, in addition, the utilities have certain exclusive advantages which should be heavily taxed. The excise tax singles out a few taxpayers for special burdens, and the result is inequality."

PENNSYLVANIA.—The House has begun its own investigation of the Public Service Commission, and this is running simultaneously with the Senate's investigation. The Governor appointed Morris L. Cooke of Philadelphia (his right-hand man on power questions), H. J. Walker of Emlenton and the Rev. James Cox, a Pittsburgh priest, as his representatives on the House committee, which has asked the commission to supply it with information under sixteen heads covering its personnel, expenses and decisions. The House inquiry began in the presence of 1,582 persons from the Scranton-Wilkes-Barre district who were there to protest against alleged exorbitant water-company rates in their district. Much criticism has been directed against Governor Pinchot for standing on his executive rights in refusing to answer questions when he read his statement before the Senate committee. The five utility companies he accused of exorbitant profits have been named and the fact disclosed that all are small independent concerns operating in small communities. Their officers are being examined by the Senate committee. This committee has already made a preliminary report which advocates (1) the institution of a people's counsel and a provision for financing complaints from the public; (2) suspension of rates for a period not exceeding six months pending a hearing and determination by the commission; (3) securities commission's or Public Service Commission's prerequisite approval of all securities of the public utility companies. John R. Farr, former Speaker of the House, is under the Senate committee's displeasure for refusing to name a Scranton banker who, he says, accused the commission of collusion in the water-company case.

TEXAS.—Provisions of the Holbrook bill for a state-wide utility commission are that a utility raising rates shall file a bond to identify customers if the higher rate is not sustained by the commission or the courts, that a sliding scale of rates must not make discriminations, that a would-be competing utility must not install a plant without making an effort to purchase the existing utility, and that all future franchises shall be indeterminate permits, subject to all regulatory provisions.

WEST VIRGINIA.—The Hodges-Watkins water-power bill, passed by the House, as reported last week, went to the Senate judiciary committee for further hearings after a vigorous effort to place it on the calendar of the Upper House for second reading and debate. The vote for delay was 16 to 13.

WISCONSIN.—State ownership and operation of utilities received final approval of the Legislature when the Assembly, without debate and by a vote of 85 to 8, concurred with the Senate in adoption of the resolution sponsored by Gov. Philip F. LaFollette. Similar action by the 1933 Legislature and ratification by the people are required before the measure can become effective. A bill to make the state pay county taxes on any utilities it may take over was killed in the Assembly by a vote of 50 to 31. A measure to prohibit a demand charge by light and power companies was beaten in the Senate by 17 to 13. Sensational charges of bribery by utility interests were made in the debate on this bill. By a unanimous vote the Assembly adopted a resolution to amend the state constitution so that a municipality shall not be bound by the present 5 per cent debt limitation in the acquisition of utility property.

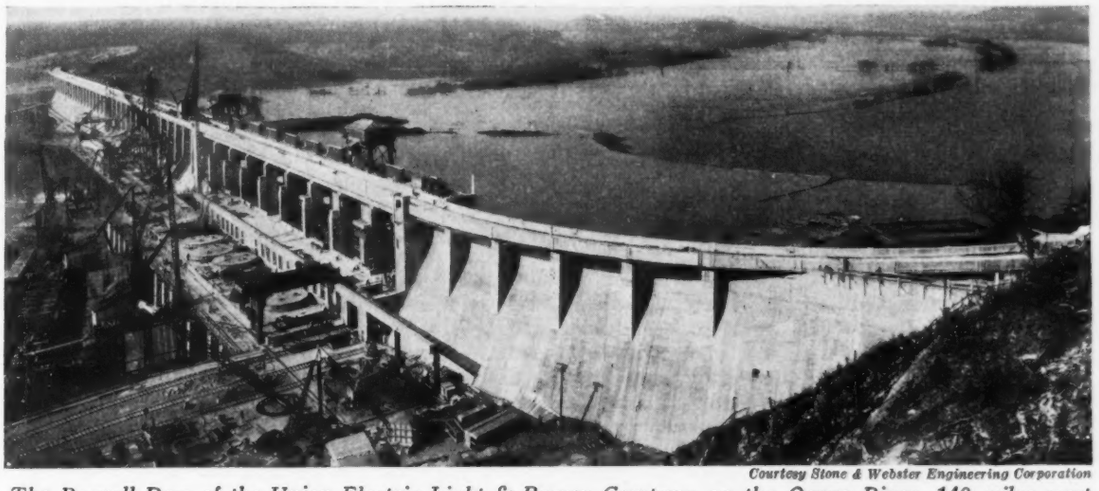
▼

Oregon Revolutionizes Its Public Service Body

ONE MAN IN PLACE OF THREE, and this man with a special mandate to represent the users of service and the public generally, now sits as the regulatory authority over the valuation, rates and service of the public utilities operating in the State of Oregon, in accordance with the new Public Service Commission act passed by the Oregon Legislature and signed by the Governor on February 28. The act carries the emergency provision which made it effective immediately, and the Governor has appointed C. M. Thomas, Medford, Ore., attorney, to the newly created position of "Commissioner of Public Utilities of Oregon." Simultaneously the tenure of office of

▼ ▼ ▼

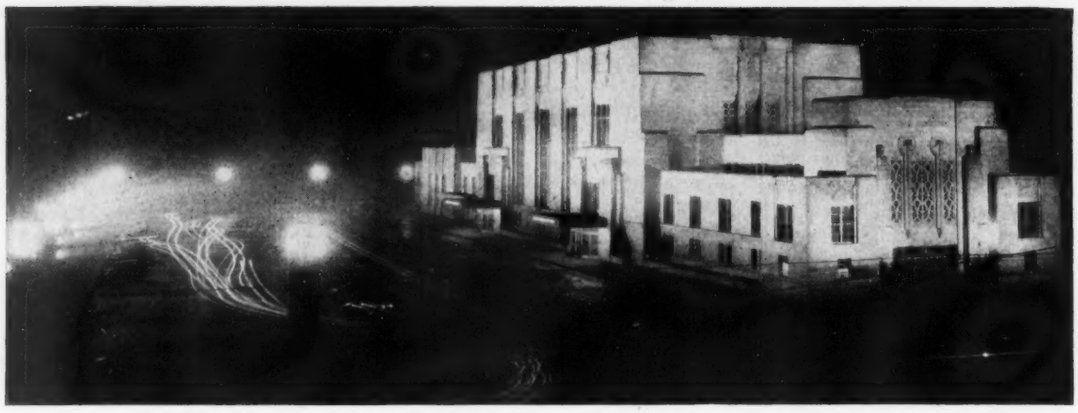
MISSOURI'S MAN-MADE LAKE SLOWLY FORMS IN THE OZARKS



Courtesy Stone & Webster Engineering Corporation

The Bagnell Dam of the Union Electric Light & Power Company on the Osage River, 140 miles west of St. Louis, has been closed, and the rising water which will create the Lake of the Ozarks, largest in Missouri, will soon obliterate the county town of Linn Creek, which fought for its life in vain. Some of the eight Westinghouse 27,500-kva. umbrella-type outdoor generating units can be seen in the left foreground. They will be driven by 33,500-hp. Francis-type waterwheels made by the Allis-Chalmers company.

FLOODLIGHTING OMAHA'S NEW UNION PASSENGER STATION



Two 1,000-watt floodlamps near the top of each of ten tall pylons and six 100-watt lamps in ornamental fixtures surmounting every pylon shed a brilliant illumination on Omaha's three-and-one-half-million-dollar terminal and in the plaza surrounding it. Interior lighting is also elaborate, and the total connected load for all purposes is more than 700 kw.

▼ ▼ ▼

Hal D. Patton, H. H. Corey and O. C. Bortzmeyer, members of the former Public Service Commission, ceased.

The clause in the new act attempting to make the new commissioner an advocate of the people is as follows: "In addition to the powers and duties now or hereafter transferred to or vested in the commissioner, it shall be his duty to represent the patrons, users of the service and consumers of the product of any public utility, and the public generally, in all controversies respecting rates, charges, valuation, service and all matters of which he has jurisdiction, and in respect thereof it shall be his duty to make use of the jurisdiction and powers of his office to protect said patrons, users and consumers, and the public generally, from unjust and unreasonable exactions and practices and to obtain for them adequate service at fair and reasonable rates."

Another principal difference between the old and the new law is found in the limited home-rule provision of the new law. This permits incorporated cities to fix by contract or ordinance the rates and charges applicable within such cities. Any such proposed contract or ordinance must then be filed with the Commissioner of Public Utilities, who may submit written objections to such contract if he believes it not to be in the public interest. If such objections are filed within 90 days, the contract or ordinance must be submitted to a vote of the qualified electors of the city or town concerned before it can be effective.

A further change effected by the new act gives the Commission of Public Utilities jurisdiction over contracts between two utility corporations "with relation to the construction, operation, maintenance or use of property, . . . or for service, advice, engineering, financing, rentals, leasing, or for any construction or management charges," under conditions in which one of the contracting utility companies owns a majority of the voting stock of the other contracting company, or when a majority of the voting stock of either company is owned by a third corporation, or when a director or officer of either contracting party has a pecuniary interest in the contract. Such contract will not be lawful under the new act if the Commissioner of Public Utilities finds that its terms are contrary to the public interest.

The new act was put through as part of the Governor's power program in accordance with his promise before election to abolish the Public Service Commission.

▼

New Co-operative Bureau Is Set up in California

UNIQUE IN SOME WAYS, the Pacific Coast Electrical Bureau has been organized as the outgrowth of the old California Co-operative Campaign, organized in 1917, which was succeeded by the California Electrical Bureau. The new organization will function co-operatively with the Pacific Coast Electrical Association under supervision of the same managing director. The purpose is to effect a closer tie-in between the two organizations in order that plans produced by the association may serve as a working program for the bureau and be carried to accomplishment through its committees and field staff. Funds for carrying out the program of the bureau will come largely from the power companies, and $88,600 will, according to plans, be expended in 1931.

Columbia River Company Has 160,000-Hp. Project

UNUSUAL FEATURES CHARACTERIZE the plan of the Columbia River Power Company, Seattle, for developing 160,000 hp. on the Columbia River between Cascade Locks, Ore., and Stevenson, Wash., without a diversion dam, as outlined in the company's application for a preliminary permit to the Federal Power Commission, recently filed. The scheme is to construct along the Washington shore of the river an open canal 6,500 ft. in length with its intake about a mile below Stevenson, above the Cascades. This canal, which would be 300 ft. to 400 ft. wide on the bottom and 75 ft. to 90 ft. deep, would have its bed sufficiently low to divert most of the 90 per cent flow (about 90,000 sec.-ft.). It would deliver water to five tunnels about 7,500 ft. long and 40 ft. to 50 ft. in diameter, which would discharge into a forebay, into one wall of which would be built the power house near the shore line of the river below the rapids. The difference in elevation between intake and tailrace is placed at 27 ft., which after losses in canal and tunnel would be 23 ft. net head on the wheels, giving a capacity of 160,000 hp. 90 per cent of the time.

A development to be undertaken later, the application says, is a dam approximately 13 ft. high below the intake which will increase the capacity to 250,000 hp. 90 per cent of the time. The initial development is estimated to cost $15,000,000. Power to be developed is said in the application to be for industrial service and commercial power and light for the general market within economical transmission distances and for wholesaling to municipalities which own their own distribution systems.

Scattered Happenings in the Electrical Sphere

United States

PREPARATION OF THE CASE for the United States Senate in its effort to oust George Otis Smith from the chairmanship of the Federal Power Commission has been begun under the direction of John W. Davis of New York and Alexander J. Groesbeck of Michigan. Argument before the Supreme Court of the District of Columbia some time in May is predicted.

GOVERNOR GEORGE WHITE of Ohio has thrice denied a request of five Common Pleas judges of Mahoning County that he designate an investigator to probe into relations between utilities and public officials in the Youngstown district. The alleged desire of a deposed traction commissioner to use his office for personal gain in his relations with a light and power company led to the agitation and request.

AN ORDER THAT THE Utica Gas & Electric Company cut its rates so as to reduce its annual income by $69,000, made last week by the New York Public Service Commission, is predicated upon a 7 per cent return instead of the formerly customary 8 per cent. Commissioner Van Namee, while concurring with his colleagues, thought that 7½ per cent could properly have been allowed.

THE OKLAHOMA GAS & ELECTRIC COMPANY has purchased from the Lincoln Utilities Company and United Power & Light Company electric properties serving eleven small communities in Oklahoma.

ONLY FOUR APPLICATIONS have been filed to date with the Nebraska State Railway Commission by towns owning municipal lighting plants for authority to extend their service into surrounding rural territory under the law adopted by popular vote last November.

AN ENTIRE TICKET pledged to work for lower electric rates, with the possibility of going into municipal ownership, has been elected at Bemidji, Minn., in an election that aroused great interest. A controversy with the Interstate Power Company arose on the expiration of a contract last fall and led to the issue.

A STATE FRANCHISE for transmission lines on the new Pacific Highway from Seattle to Everett has been granted to the Great Northern Power Company, which contemplates plant and line construction to cost more than $2,000,000 and expects to be ready to furnish power by December. The company will develop sites on the Olney River and both forks of the Wallace River. Installation will be 30,000 hp. A plant of 1,200 hp. is already operating.

A NEW SCHEDULE of electric rates has been filed with the State Corporation Commission by the Virginia Electric & Power Company. It provides for a flat reduction of about 12 per cent to nearly all domestic users and many commercial users. These rates effect a saving of $450,000 annually to more than 90,000 customers.

A GAS WELL, the first in Steuben County, N. Y., and said to produce 9,000,000 cu.ft. daily, owned by the Lamoka Power Corporation, will be used by that company to furnish fuel for generators to be installed in its Lake Keuka plant, supplementing its 3,500-hp. hydro output. A total of 13,000 hp. in mixed equipment is planned, the energy under existing contracts going to the New York Central Electric.

AFTER BEING HELD UP by city authorities in St. Paul for more than a year, the Bemis report on the valuation of the property of the Northern States Power Company in that city is to be presented to the City Council. The valuation placed upon its St. Paul properties by the company is $43,000,000. The Bemis valuation was $39,000,000, against which is depreciation of approximately $9,000,000.

CONTRACT FOR CONSTRUCTION of Hoover Dam, with its power house and appurtenant works at Boulder Canyon, has been awarded by Secretary Wilbur to the Six Companies, Inc., of California, on the low bid of $48,890,999 reported last week.

AMESBURY, MASS., has defeated by 356 to 127 a proposal to buy out the Amesbury Electric Light Company and establish a municipal system. This result followed three years of agitation.

A COPIOUS RAIN at the last week end has improved the outlook in northern Kentucky, one of the regions hit hardest by long drought. The water rose several feet in both the Dix and the Kentucky River, facilitating operation of hydro plants.

NO REVIEW of the New Jersey submetering suit will be made by the United States Supreme Court, that body announces. State courts, it will be remembered, upheld the refusal of the Board of Public Utility Commissioners to order the Public Service Electric & Gas Company to supply the owner of an East Orange apartment with a master meter to enable him to retail energy to his tenants through submeters installed by a meter company.

Canada

THE CANADIAN PARLIAMENT at its forthcoming session will be asked to sanction incorporation of the Ontario-Quebec Canal & Power Company for the development of the international section of the St. Lawrence River between Cardinal and Cornwall, Ontario, for navigation and power purposes, together with the construction of a navigation and power canal in Beauharnois County, Quebec.

THE QUEBEC GOVERNMENT, according to a statement by Premier Taschereau, will authorize the Beauharnois Power Corporation to increase the amount of water which it may use from 40,000 sec.-ft. to 70,000 sec.-ft., thus enabling the corporation to increase its output (originally placed at 500,000 hp.) to serve additional customers.

Abroad

THE TENTH ANNUAL REPORT of the British Electricity Commission shows that twelve-month records of generation in Great Britain were broken in 1929-30 with the production of more than 10,000,000,000 kw.-hr. Total value of all contracts for stations, equipment and transmission placed by the commission up to March 31, 1930, is placed at $61,250,000.

Coming Meetings

Artistic Lighting Equipment Association—New York, March 16. C. L. Benjamin, 420 Lexington Ave., New York.

Northwest Electric Light and Power Association — Commercial Section, Spokane, Wash., March 16-18; Engineering Section, Wenatchee, Wash., March 18-20; Accounting Section, Salt Lake City, April 13 and 14. B. Snow, 1208 Spalding Bldg., Portland, Ore.

New England Division, N.E.L.A.—Joint meeting Commercial and Public Relations Sections, Hotel Statler, Boston, March 20. Miss O. A. Bursiel, 20 Providence St., Boston.

Southeastern Division, N.E.L.A.—Vinoy Park Hotel, St. Petersburg, Fla., April 1-3. C. M. Kilian, 508 Haas-Howell Bldg., Atlanta, Ga.

Arizona Utilities Association—Biltmore Hotel, Phoenix, April 8-11. J. S. Arnold, 300 West Washington St., Phoenix.

Great Lakes Division, N.E.L.A.—Engineering Section, Chicago, April 9-11. L. F. Hickernell, Consumers Power Bldg., Jackson, Mich.

Maryland Utilities Association — Lord Baltimore Hotel, Baltimore, April 10. D. E. Kinnear, 803 Court Square Bldg., Baltimore.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 16-18. F. D. Beardslee, 315 N. 12th St., St. Louis.

Southwestern Division, N.E.L.A.—Mineral Wells, Tex., April 21-24. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

Electrochemical Society — Hotel Tutwiler, Birmingham, Ala., April 23-25. C. G. Fink, Columbia University, New York.

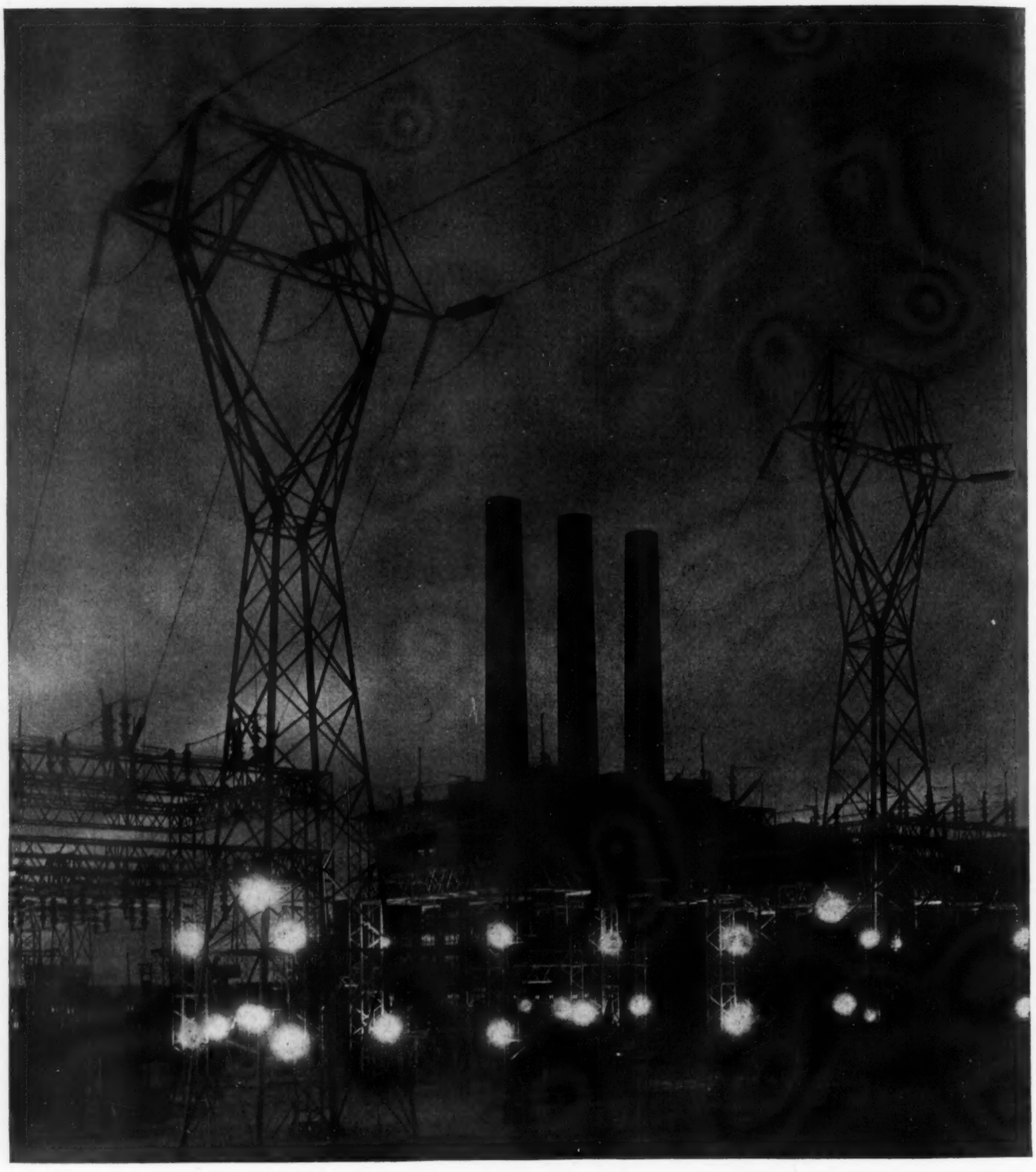
American Institute of Electrical Engineers—District meeting, Rochester, April 29-May 2. F. L. Hutchinson, 33 W. 39th St., New York.

East Central Division, N.E.L.A.—Deshler-Wallick Hotel, Columbus, Ohio. May 11-13. D. L. Gaskill, 603 Broadway, Greenville, Ohio.

National Electrical Manufacturers' Association—Hot Springs, Va., May 18-23. A. W. Berresford, 420 Lexington Ave., New York.

Middle West Division and Nebraska Division, N.E.L.A.—Excelsior Springs, Mo., May 20-22. Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

National Electric Light Association—Atlantic City, June 8-12. A. J. Marshall, 420 Lexington Ave., New York.



Ashtabula at Night

A more significant contrast than just that of light and darkness appears in this picture of the new Ashtabula station of the Cleveland Electric Illuminating Company. Looming massive in the background is the power house, its solid, weighty bulk attesting its place as a foundation stone of the system. In front are the take-off towers of transmission lines whose conductors, mere tenuous threads in the dark, seem by comparison frail highways to carry away the product of such a factory.

EDITORIALS

L.W.W.MORROW
Editor

Take the gyrations out of the business cycle

THERE is much less willingness to accept the heights of ecstasy and depths of despond as inevitable manifestations of American business than was evidenced in connection with previous depressions. Not only "should something be done about it," but it is recognized that something can be done about it. The nation feels itself not to be wholly at the mercy of undiscerned and uncontrollable economic forces. Most of the factors which converted our recent era of plenitude into one of gloom and restraint are recognized. To a large degree there is a basis for hoping that business can be stabilized by applying the lessons of the latest débâcle.

The February 28 issue of the ELECTRICAL WORLD carried as a supplement a suggested platform for American business. If the present standards of living are to be maintained and the hazards of unemployed labor and hesitant capital replaced by security and confidence, then future expansion must be orderly; planning must be based on longer budgeting; credits must be staggered as to placement, duration and call, and governmental incursions must be curbed or transformed into beneficial stimuli. The hope that our late Congress would reveal a superior statesmanship faded while it was frittering away its mental capital in purely political machinations that unfortunately have caused the people to underestimate their own stamina for economic convalescence by using Congress as a yardstick.

If business is to recover, it will be on account not of what government does for it but of what it does for itself—especially if let alone. The platform presents a foundation for the solution. The electric utility industry hardly needs such advice or encouragement. It is the prime example of stabilized industry. It is also coming to be recognized as the most fundamental of props for the present standard of living and wage scales. Hence we look to it as an aid to helping its local industries smooth out the fluctuations. On the other hand, the manufacturing division of the electrical industry has shared with other industrial enterprises the curtailed market and shrunken credits that spell depression. To this group as well as to all others affected with an electrical interest we commend the proposals for stabilization as timely, lucid, operable and adequate.

Maintenance and reserve funds

A MORE or less historical basis, and one built more or less on what accounting shows, exists for determining the sum of money a light and power company should set aside each year to keep up its property. From the standpoint of the accountant and the banker each item of physical property should have its life fixed and a fund should be set up to retire it in so many years. To the executive of the property a utility is a going concern with a multitude of items of physical value and his problem is to earn the total sum to be set aside each year for reserve and maintenance. A bookkeeping total based on theoretical life expectancies is often found to grow too large, especially if surplus funds cannot be used for earnings.

It would seem advisable to find out the actual expenditures on properties each year over a period of years for maintenance and replacement purposes and thus arrive at a total average yearly fund that would have a basis corresponding more closely with facts than the too frequently used

estimate or percentage method. The experience data concerning actual expenditures of metropolitan and transmission properties should give a fair guide to the industry for placing retirement funds on the foundation of past experience instead of hypothetical expectancy.

March, the lion, puts utilities on their mettle

IF THE old adage again holds true, March, which came in like a lamb, will go out like a lion. Indeed, the eccentric month has not waited for its exit to show its roaring and tail-lashing proclivities. Already many public utilities across the country have felt its blasts and have had to fight in their time-proved manner to maintain service uninterrupted where humanly possible and to restore it promptly where the elements have momentarily won a victory.

Considering the extent and intensity of the week-end storm, most companies deserve great credit for the precautions they had taken to meet such disturbances and for their swift victory. Successful defenses against the vagaries of the weather demonstrate the wisdom of planning systems for emergency operation and of so developing system and trouble dispatching that exigencies can be met the instant they arise. Such engineering precautions include line and switching facilities that permit rerouting of power supply, maintenance of strategically located steam standby stations, multiple interconnections with adjacent systems, automatic relaying for isolation of faults, and sectionalizing facilities. Protection of overhead distribution circuits from trees still remains a problem. If distribution lines cannot be run along back property lines, away from trees, possibly the only answer is to develop a sufficiently dense residential load to justify underground service.

Regular weather forecasts are an important factor in preparing for storm emergencies, as are advance plans of attack and the absence of restrictions in contracts for the interchange of energy. And when the trouble arises a practical fighting method is found in the electrical melting of sleet. The location of extra stocks of wire, insulators and poles at strategic points is an important precaution. In some cases pole sellers and wire and insulator manufacturers have the foresight to provide an extra stock of their products at strategic delivery points and to advise the companies periodically of their availability.

The credit for maintaining service continuity during storms or other emergencies that occur frequently every year goes to engineers who design for emergencies, dispatchers who prepare for contingencies, telephone operators who route calls, station operators who are in readiness to execute orders, construction and trouble men who make sacrifices for service and the executives who organize all these activities. Little, if anything, is known by the general public of the precautions and supervision necessary to maintain reliable service. If some of the dramatic incidents that arise when utilities combat storms were more widely pictured, the critics of distribution costs would understand better why the selling price of electricity is so much in excess of the cost of producing it.

A new record

AMONG a number of inspection trips and other interesting events arranged in connection with the recent convention of the American Institute of Electrical Engineers there was one—unofficial, arranged on short notice and virtually unannounced—which was probably unsurpassed by any other in the interest and thrill it gave to the group of engineers who were privileged to be present. It was, in short, an attempt at the Bayonne factory of a well-known cable manufacturer to break down a sample of single-conductor, oil-filled cable designed for 220 kv. In this test the voltage was carried to more than 675 kv. without failure of either cable or terminals, the test terminating in a flashover from the high-tension lead to the steel structure of the building.

This impressive experiment probably embodied the highest voltage ever successfully applied to a lead-covered cable. It is noteworthy not only as to the high quality attained in the cable itself but equally so in its evidence of ability to meet the problems of terminal design. It has been generally

recognized for some time that the outstanding success of the first 132-kv. oil-filled cables gave promise of even bigger things and that cable manufacturers were busy in taking advantage of the new opportunities thus obtained for advance. Here, then, is concrete evidence of success—not only because a 220-kv. cable was tested to five times the normal (phase to ground) voltage, but because it was shown that careful research and courageous development give certain promise of even higher values when needed.

Case studies needed on load-building plans

AS PART and parcel of an industry based on science and engineering, electrical men believe in research, in statistics, in case studies that give clear facts on which to base intelligent action. It is a principle well proven in their technical experience. It should now be no less heartily and thoroughly applied to their commercial progress, and the recent experiment of the Central Hudson Gas & Electric Company, recounted last week in the ELECTRICAL WORLD, is a good example of what comes out of it.

Here eleven out of twenty domestic customers who have been interested in a "full-use" plan have now completed one year's experience. It has resulted in the sale of $9,100 worth of equipment and wiring to these eleven homes. The annual aggregate consumption has increased from 15,502 to 76,606 kilowatt-hours. The households have benefited by greatly increased service at an average rate very much reduced by volume consumption. Customers have purchased on long-time payments financed by the power company. Dealers and contractors have participated profitably. It has been a carefully organized laboratory experiment that points to very definite possibilities. It provides a variety of data for serious study.

This is one case. Fresno, Boston, Atlanta, Vancouver, Richmond and other cities offer other facts on new ways of promoting the growth of residence load. Each has followed a definite plan to certain definite results. Out of their experience comes information that the entire industry may use. The question is, Which plan is best, and under what conditions? Any study of the Central Hudson story suggests immediately the need for a broad analysis of recent load-building experience that will break down and classify policies, rates and methods involved so that the various plans can be evaluated and compared and the appropriate lesson be learned.

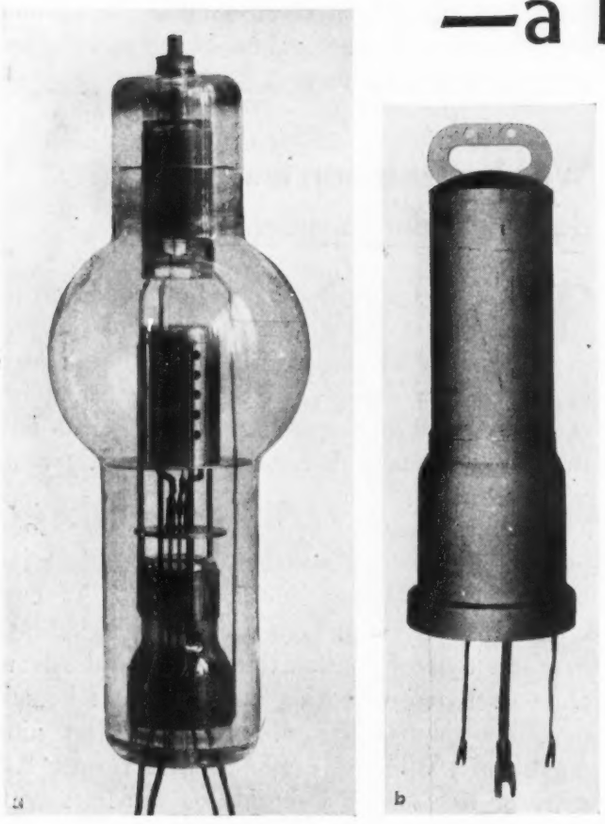
Wooden cross-arm braces deserve wider consideration

THOUGH the idea of using wooden cross-arm braces and wooden guy insulation is not new, this type of construction having been used in this country many years ago, it remained for the thorough lightning studies of very recent date to bring out serious discussions and investigations of its merits.

A report presented by the Public Service Company of Northern Illinois before the Engineering Section, Great Lakes Division, N.E.L.A., contains many interesting facts which seem to indicate that this type of construction has several advantages over one employing steel braces and small porcelain guy insulators. For the first nine months of 1930 there were 42 flashovers per 100 miles of line due to lightning on the lines with steel-brace construction and no flashovers per 100 miles of line on those with the wooden-brace construction. The number of cases of line repair per 100 miles due to 60-cycle flashover was 30 on the steel-brace line and none on the wooden-brace-wooden-guy line. There were 33 cases of serious pole and arm damage per 100 miles due to splintering by lightning on the steel-brace construction and none whatever on the wooden-brace construction.

Though a great deal of development and standardization is still left undone on wooden braces and wooden guys, and though considerable difficulties are involved in stress calculation when the spans are comparatively long, these problems will all become less as the method becomes more popular. There seem to be excellent prospects that the use of wooden braces and long wooden-guy insulators will soon be more widely accepted for wooden-pole lines.

D.C. Transmission —a bright promise for th



Power tubes of recent design

(a) High-voltage developmental lamp "Thyratron" for 75-amp. average current.
(b) Low-voltage developmental metal "Thyraton" for 100-amp. average current.

IMPORTANT modifications in transmission and interconnection practices are impending through the introduction of vacuum tube devices into heavy-duty power company service. A review of the situation with development engineers who have a tremendous vision of the possibilities involved and a healthy respect for the unknown factors and inevitable pioneering difficulties leads to the conclusion that the "Spirit of Progress" is abroad to the very definite advantage of the electric utility engineer's sphere of activities. A gradual evolution, as yet in the early stages, from a research idea to commercial equipment production, and ultimately to various practical adaptations, is well under way. The infant idea may reach a glorious maturity, but one must walk before he can run. Just now the talking age has been reached and it is a little soon to decide definitely upon a career, although ambitious and proud parents are expressing apparently well-founded hopes.

Essentially, since "Thyratrons" (three-element, mercury vapor vacuum tubes) are capable, with high efficieny, both of rectifying alternating current and inverting direct current to alternating current of any desired frequency,* the suggestion involved is to utilize direct-current energy for tie lines, interconnections, transmission by tower line or cable, frequency changeovers, etc., by generating alternating current, converting to direct current and inverting later to alternating current.

The advantages which would be realized with direct-current transmission, as evaluated recently by General Electric Company engineers for a representative of ELECTRICAL WORLD, would begin at the generating station and carry through the whole system.

In parallel operation of a direct-current system the load division between generators or between circuits can be wholly controlled by adjustment of the respective voltages. With alternating current the amount of power flow can only be controlled by means of the governors of the prime movers and change of voltage only results in modifying the distribution of circulating current. These characteristics are fundamental, and therefore it may be said that direct-current systems are much more stable in operation and the operators are in control of the system, while with alternating current the system controls the operator to a certain extent.

Generator costs could be reduced

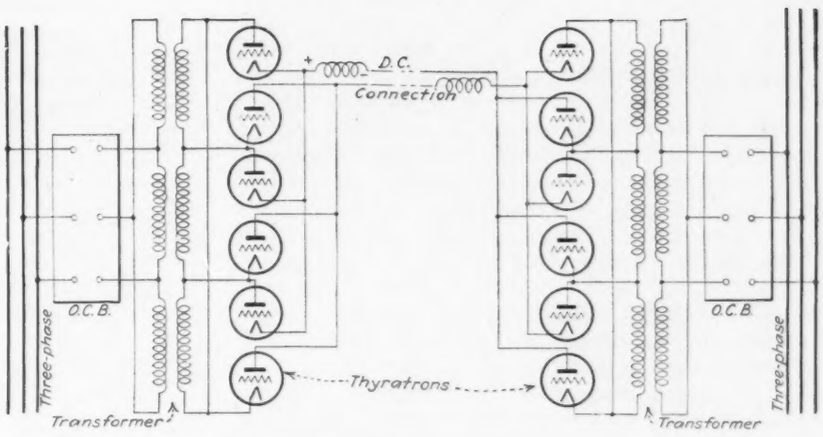
Under this plan all generators could normally be operated at practically unity power factor and could be designed for any voltage or frequency which would give the cheapest, most efficient and most reliable operation. This may mean voltages and frequencies other than those now in general use. It is estimated that there should be considerable savings possible here in equipment costs through reduction of generator sizes. Further, it would be possible to utilize machines of lower stability factor, since system stability as related to generator characteristics would be entirely out of the picture. Upon this basis the temperature rise could dominate the design. Problems of inductive interference would not be so important and designers would not have to balance economics of design against this latter, increasingly important factor.

Trouble incident to parallel operation of units and the synchronizing of units, of course, would disappear with

*Abstracts from "Distribution of Electric Power with High-Voltage Current," a paper presented by C. W. Stone of the General Electric Company at the fifth Midwest Power Engineering Conference, in Chicago, have been incorporated in this discussion.

the future

An a.c.-d.c.-a.c. set-up using "Thyratrons"
Grid and filament circuits not shown



such a system, as the units would be paralleled only through direct-current ties.

High-voltage oil circuit breakers of large interrupting capacity will not be necessary with direct-current transmission. The "Thyratron" tube is essentially a one-way device. Concentration of large amounts of power in event of a short circuit would be limited. No power could flow back from the inverter and the only power which could flow into the short would be that which would pass through the rectifier. By suitable arrangement of control, the short circuit flow could be stopped in a fraction of a cycle, or, if preferred, could be limited to full load on the circuit, or less. Switching operations will be carried out on the low-voltage a.c. side of the transformers by means of suitable oil circuit breakers or on the d.c. side of the converting equipment with the lines dead by means of disconnecting switches. Switching high-voltage direct current, such as would be required by line taps and interconnections, will be avoided, as such operations present problems yet to be solved.

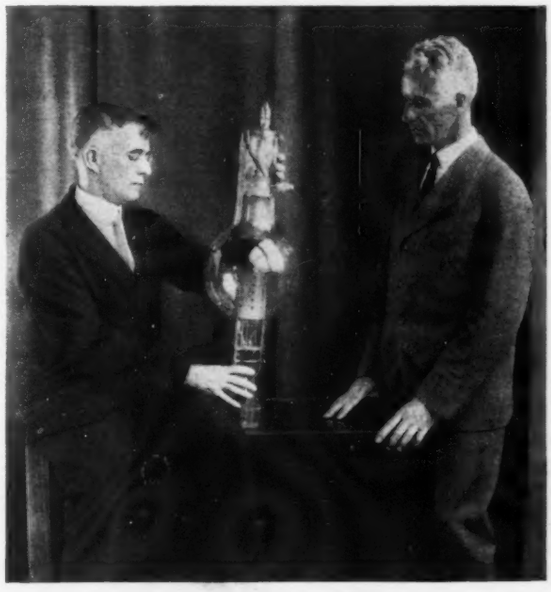
When it is desirable or necessary today to tie together two systems, some attempt is usually made to control the flow of power or the exchange of wattless energy over the tie. Frequency-changer sets of one type or another, transformers designed for tap changing under load and phase shifting are among the means employed to this end, with varying success. When such ties can be made with "Thyratrons" it will be possible to control very definitely the amount and direction of flow of power, and since these tubes will not transmit the wattless component, that problem so troublesome to present-day operators will disappear. When direct-current transmission becomes an accomplished fact we may confidently expect an increase in the number of interconnections, with marked benefits to all concerned.

In the field of transmission the introduction of "Thyratrons" would appear to offer great possibilities. Studies have been made to establish the possibilities of altered economics in the location of steam stations with relation to fuel sources and utilization centers, but costs are difficult elements to discuss where research is so far ahead of practice and yet so much in the transition stage itself. Even though the new system added something to over-all costs, and this is not necessarily true, under certain conditions the operating advantages would seem to warrant it.

The cost of the transmission circuits themselves would be materially reduced from what they now are when direct-current transmission becomes an established fact. With reasonable costs of the terminal equipment necessary to make rectification and inversion possible, the use of direct current will allow the economic transmission of power over aerial lines to considerably greater distances than can be attained with alternating current. This should be of great aid to the development of water power that is far from the point of utilization.

Direct-current transmission over overhead lines presents an attractive field for speculation when the insulation requirements are considered. While present construction could be economically adapted to the new conditions, new construction would offer an interesting field for experiment. Present insulators are based upon requirements of electrostatic capacity rather than on resistance. The latter factor will probably affect high-voltage line insulation when direct current is used. Nor is a great deal known about d.c. corona. Apparently it does not occur until voltages are reached in excess of those ordinarily employed for alternating-current transmission. What its effect may be on insulators and conductors is difficult to predict.

Using direct current, the reactive voltage drop and its companion problems of regulation and stability disappear.



Developmental power tube of large size
(Messrs. Langmuir and Hull of the General Electric Company)

The cables leading away from the power house might be either single conductor or multiple conductor, but probably they would be single-conductor cable in new construction; that is, positive in one cable and negative in the other. Thus joint troubles should be materially reduced. Reactance and capacity effects will be unknown and the only limit to the distance of transmission becomes the economic balance between the cost of the line and the cost of losses from resistance only.

Cable for use in direct-current transmission would be of solid dielectric, rather than oil-filled, since charging currents, voids and ionization would pass out of the picture, leaving heating losses as the limiting factor.

Two single-conductor cables would probably take the place of the present three-conductor ones. Single conductors in a pipe without a lead sheath might be used. It might be that, because of greater life expectancy, trench-laid cable would take the place of the present duct-laid system, since failures would be greatly reduced with d.c. cables. With alternating current the electrostatic capacity of the cable is a serious factor and limits the length of circuit, particularly at high voltages and large power capacities. Ohmic resistance only needs to be considered with direct current. This and the economics of a particular case are the only limitations to the distance that can be covered or the power transmitted.

It is anticipated that the ratio of cost of underground to overhead construction, using direct current, will be less than the same ratio using alternating current. Experience in operating with direct-current circuits, both overhead and underground, together with improvements in design and manufacture of cables, may well lead to a large increase in the number and length of underground circuits. The freedom of the latter from lightning disturbances and, hence, increased continuity of service will be important factors in future decisions.

If direct-current transmission circuits are operated on the Edison three-wire principle, with the neutral grounded, switching and bus structures will be very much simplified, as only two bars need be used—one for the positive and one for the negative—and these can be put in separate parts of the structure so that the two potentials will never come together.

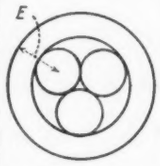
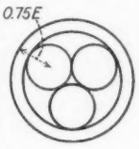
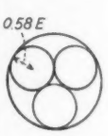
Networks tied at high efficiency

In many cities there are 60-cycle and also 25-cycle alternating-current networks. The only way such systems can now be connected together is through motor-generator sets, and these are expensive, inefficient and more or less uncontrollable. Thyratrons, with their simple control and small losses, will make such ties very efficient.

Another probable application of "Thyratrons" will be as one-way ties between alternating- and direct-current networks. In this case the "Thyratrons" would be connected as rectifiers and power would flow from the alternating-current network into the direct current if it were needed there as long as the alternating-current voltage was maintained high enough. In the event of a drop, current flow would stop, and in no case could it flow in the reverse direction. In case of a drop in voltage on the direct-current network the current flow from the alternating-current network could be limited to any amount desired by simple automatic control.

As such installations would be static and non-synchronous, they would act in many ways like a storage battery, always staying on the system and carrying load as long as the alternating-current voltage was maintained and picking up their load without attention as soon as the alternating-current voltage came back to normal.

Primary cables used in large cities in a great many cases have full insulation to ground, and as they should be capable of standing at least double potential if direct current were used, another way of operating such feeders may be considered. Where a feeder is run out to

	Delta Cable	Wye Cable	Shielded Cable
			
Two cables operated on A.C. (Unity P.F.)	2(1.73) EI	2(1.73) EI	2(1.73) EI
Two cables operated on D.C. (a)	(3I)(2x2.5E) =15 EI	(3I)(2x2.5x0.75E) =11.25 EI	(3I)(2x2.5x0.58E) =8.7 EI
Ratio D.C. to A.C.	4.3	3.25	2.50

(a)=The three conductors of one cable positive, those of the other negative

Present cables would have greater capacity under d.c. operation

a substation it is usual to run out more than one cable; this means there are at least six conductors in the ground. Upon the basis of the old Edison three-wire system we could connect each of the three wires in one cable to a "Thyratron" rectifier, the other side being connected to the ground. Thus all three wires in one cable on a 13,200-volt circuit could have 26,400 volts and each of the three wires in the other cable could be operating in the same way but at opposite polarity, and we would have three circuits instead of two. The operating potential would be 52,800 volts per circuit. Such an installation would mean a large increase in circuit capacity, probably more than would be required to meet growing load conditions.

Another way to apply "Thyratrons" would be to connect the six conductors in the same way—that is, three conductors in one cable as positive and three conductors in the other cable as negative—but operate the circuit at the same potential as now; thus the insulation stress on the cables would be greatly reduced and they might last almost indefinitely.

In order to compare these methods of operation, assume a circuit operating at 13,200 volts, three phase and 300 amp. capacity. Thus with three-phase alternating current the capacity of each circuit would be $13,200 \times 1.73 \times 300$ volts or 7,000 kw. approximately and 14,000 kw. for two circuits. Using the first case for direct current, we would have $300 \times 52,800 =$ 15,840 kw. per circuit and in round figures 45,000 kw. for the three circuits. Using the second case—that is, not raising the voltage on each conductor the amount that the insulation is good for—we would have $26,400 \times 300 = 7,920$ or approximately 8,000 kw. per circuit or 24,000 kw. for the three circuits. This indicates clearly that the same underground circuits can be used to transmit 50 per cent more power with direct current

than they now do with alternating current, or, by raising the voltage, to transmit at least three times as much power with greater safety and complete control.

In the above discussion it was assumed that the cable insulation was good for twice the alternating current operating voltage to ground. Cable insulation may be divided into three general classes: Delta cable, with the belt insulation equal in thickness to the conductor insulation; Y cable, with the belt insulation one-half the thickness of the conductor insulation, and the shielded type, with full insulation to ground on each conductor. If we assume that the operating voltage and current for alternating current operation are *EI* respectively, and that a direct-current voltage $2\frac{1}{2}$ times the alternating can be used, the accompanying figure shows the relative amounts of power which may be transmitted.

As stated above, direct-current transmission as at present discussed will not transmit the wattless component. It will be used for energy transmission only, and the wattless current required will either have to be obtained locally by means of static capacitors or rotary condensers or will have to be transmitted by other feeders which are operated with alternating current.

How the thyratron works

A "Thyratron" is in its essentials a three-element vacuum tube consisting of a cathode, anode and grid. Two types have been developed, one with a mercury pool, apparently best suited for the handling of large currents at relatively low voltages, and the other of the hot cathode type, which is better adapted to lower currents and high voltages.

In most other types of electron tubes the amount of current which flows through the tube is controllable by the polarity and voltage impressed on the grid, but in the "Thyratron" no current will flow unless the grid is made more positive than some predetermined critical voltage, which may be positive or negative, depending upon the particular design. If the grid is made more positive, or reduced to zero, or even if the polarity is reversed, the amount of current flowing is unchanged. If an alternating current is connected to the tube current will flow for half of the complete cycle, but it will not flow unless the connections are reversed for the other half cycle and, as before stated, unless the grid potential is above its critical value.

If after the first half cycle of current flow the grid is made negative, the next half wave, when the alternating current reverses, will not pass, so that the tube is essentially a unidirectional valve which can control the starting of current flow, but has no control over the amount of current while it is flowing, except that the amount of power can be controlled by the portion of voltage wave during which current can flow.

By suitable connections, two such tubes can be used, one for the positive half wave of alternating current and the other for the negative half wave. Again by changing the connections, the direction of flow of current may be changed by first allowing the current to flow in one tube and then in a second one. With alternating current applied to the thyratrons in the first case current will flow from them as direct current. In the second case, with direct current connected to the "Thyratron," alternating current of any desired frequency will result.

The development of tubes for the purposes outlined is proceeding along orderly lines. At the present time attention is being concentrated on tubes of moderate voltage and ampere capacity. Such tubes can be used to rectify and invert power up to approximately 9,000 kw. maximum at 30,000 volts. While it is theoretically possible to employ higher voltages and larger powers, such combinations would require a multiplicity of tubes and practical considerations will postpone such installations until experience has been gained with these tubes under actual operating conditions in other classes of service.

A tube of lower voltage is also available which can be used to rectify alternating current for the purpose of feeding Edison three-wire networks. A single equipment employing this tube will have a capacity of 150 kw. at 250 volts.

As the loss in the thyratron is very small, equipments employing these tubes operate at efficiencies not possible of attainment with any other equivalent electrical device. It is interesting to note that as the voltage drop in the tubes is a constant, tube equipments maintain their high efficiency throughout their entire range of load.

So it stands; research has gone far, and it is willing to say that through continued study tubes of larger capacity and higher voltage may be produced. Production is not willing to hazard a guess at what cost, of what appearance, design or physical characteristics. Experimental use will point the way through clearing up of difficulties by trial under various conditions.

As C. W. Stone pointed out, in Chicago: "It may appear to you from what I have said that I feel the millennium is here, but, of course, this is not the case. The manufacturer cannot work out the problems without the full co-operation of the operating engineers. He can only develop the devices and test them in various circuits and principles. All the problems of generation and distribution of power by use of the thyratron are not solved. Laboratory tests and theoretical considerations would indicate that all of the things which I have mentioned can be done, and perhaps many others, but it will require patience and time to work out all of the details."

▼

Dairy Uses 60 Watts per Quart

Electrical modernization of a large dairy plant at a cost of $42,000 promises a reduction of $7,500 annually in the total of $175,000 expended for power, labor, fuel and repairs. Refrigeration (680 tons) and power plant auxiliaries remain steam-driven, but the electrical consumption is expected to be more than 240,000 kw.-hr. per month at 94.2 per cent power factor. Average demand is computed at 887 kva. with a maximum of 962 kva., according to Messrs. A. J. Dreux and H. C. Brunner in a recent A.I.E.E. paper.

Electropure pasteurization of the milk by passing current through the milk and establishing the pasteurization temperature by electrolytic losses is the process used. Six units together handle 13,200 quarts per hour and consume 48 kw. each at 220 volts a.c. applied to the carbon electrodes. The balance of the plant load is represented by circulating pumps, bottle washers, ice cream machinery, conveyors, elevators, fans and blowers.

Network Promises Marked

By D. K. BLAKE

Central Station Engineering Department,
General Electric Company, Schenectady, N. Y.

—Reduces system costs
—Simplifies construction
—Improves service
—Allows use of standard single-rated equipment
—Permits mass production of apparatus

THE network principle promises to reduce light and power system cost and to improve service standards if it is applied to the several voltage levels used in the industry. It simplifies system layout and engineering. It makes possible the manufacture of standard apparatus of a single rating on a production scale. It reduces the system investment per unit of capacity and improves service standards at a minimum cost.

For the 120-208-voltage level in metropolitan distribution systems the alternating-current network system is now accepted and has been installed in many cities. It has simplified layouts, reduced costs, made possible the use of standard single-rated equipment and improved service standards. This development is not yet complete, but it has gone so far as to indicate that

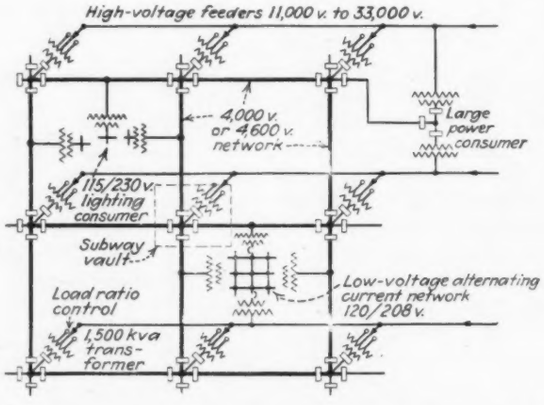
all metropolitan distribution systems should be developed toward the installation of the low-voltage network as the ultimate goal.

But for the next higher voltage level the network principle offers tangible advantages so great that it should be applied to 4,000-volt distribution in many metropolitan systems. This can be done readily by using it for all extensions or additions to the existing installation in a step-by-step program for the ultimate use of the 4,000-volt network for the entire system. Actual studies on several properties show capital savings of from $15 to $25 per kilowatt in favor of the 4,000-4,600-volt network and a very great simplification of the system from generators to consumers. The primary network results in cost reduction, greater simplification, greater flexibility, greater standardization and better service. It is the most revolutionary step in electrical distribution since the introduction of alternating current.

The 4,000 to 4,600-volt network is made by interconnecting existing or installed overhead circuits into loops or networks. These primary networks are fed from generator feeders or from the next higher transmission voltage system at any desirable number of points and the networks are tapped to supply the distribution transformers needed for the next lower voltage level.

In essence, the 4,000-volt network means that each street has a single 4,000-volt, four-wire primary circuit of one size cable or conductor; it means that the large capacity substation with radial distribution is eliminated in favor of a number of small distribution substations located in streets or buildings adjacent to load; it means that standard breakers, transformers and protective equipment can be used and all have identical ratings; it means these network substations can be located near the loads and that system capacity can be added in small units when and where needed; it means virtually no obsolescence expense for the equipment is used until it wears out.

A transformer with regulating equipment supplies energy to the 4,000-volt network at intersecting mains. Oil breakers with automatic reclosing features provide full protection and there is no necessity for high-voltage (11-kv. to 33-kv.) breakers.


High-voltage feeders 11,000 v. to 33,000 v.
4,000 v. or 4,600 v. network
Large power consumer
115/230 v. lighting consumer
Subway vault
Load ratio control
1,500 kva transformer
Low-voltage alternating current network 120/208 v.

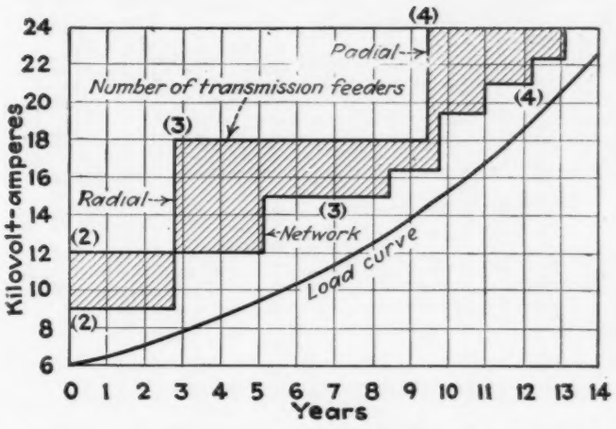
The medium-voltage network is composed of simple elements

The adaptibility to large power loads and ease of multiple supply to small 120/208-volt networks from either 4,000 or 13,200 volts is indicated.

The description* of the system in the ELECTRICAL WORLD suggested the use of 5,000-kva. transformers. The engineers of the Byllesby Engineering & Management Corporation found in applying the system to Pittsburgh that a 1,500-kva. unit was preferable for their conditions and showed very substantial savings. It is believed this rating is preferable for

*"*Serving a Medium-Voltage Network," by D. K. Blake, "Electrical World," page 501, March 5, 1927.*

Economies



Substantial savings are possible due to smaller increments of network vaults

Tapping of nearby transmission lines delays addition of new high-voltage feeders for the network.

other cities as well and becomes practically universal in application. This smaller rating easily permits subway installations which simplify the proper locations of the network substations. Furthermore, this rating makes it easy to begin a network in lightly loaded or isolated territories.

There are so many advantages of the network system (any one of a number would be decisive, other points being equal) that it is not at all necessary to appeal to lower capital invested and capitalization of losses. Nevertheless, it is believed that substantial savings in investment of $10 and $25 per kva. will be very common. This statement is based on studies of various ideal conditions and actual localities in five different cities.

A fault anywhere on the 4,000-volt network mains or branches interrupts about 500 to 800 kva. of load, whereas the present radial system interrupts about 1,000 to 2,000 kva. of load. Furthermore, the actual number of faults are reduced somewhat by the elimination of many miles of 4,000-volt feeders. Finally, great care is taken in radial substation design to avoid putting too many eggs in one basket, but a fault on a network substation bus does not interrupt any load; in other words, there are no eggs in the basket.

The uniformity of the network greatly simplifies regulating methods. Automatic load ratio control in the network transformer may be substituted for the usual feeder regulator and thereby permit a wider range of voltage conditions in the transmission system, with attendant savings. The drop in network mains is so small as to permit the assertion that 100 per cent voltage is maintained at every substation at ¼- to 1½-mile intervals, with no variation on the network mains exceeding a 2 per cent range. A vast territory overlaid with a primary system having variations within ± 1 per cent would surely result in a very substantial increase in revenue, though it cannot be satisfactorily estimated, as well as rendering a class of service far superior to any in the past. No additional words should be necessary to drive home the tremendous significance of this network feature.

The medium-voltage network is fully adequate for a range of load densities from the low-density residential areas to well beyond the high densities at which the now well-known 120/208-volt secondary network, with its continuity superiority, becomes economical. The following table clearly indicates the range with 1,500-kva. transformers uniformly spaced over a territory:

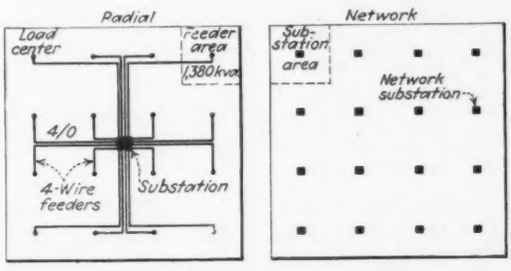
Spacing of Substations, Miles	Load Density, Kva. per Square mile
2	300
1¼	535
1	1,200
½	4,800
¼	19,200

Thus one system utilizing one equipment is built up (not reconstructed, reconditioned or revamped) and fully adequate for a load density increase of 64 times the lowest.

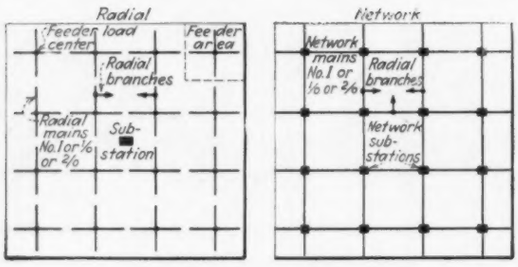
The uniform character of the network and its smaller substations provide a smaller increment investment for load growth.

Thus accurate long-range load forecasting for distribution purposes becomes unnecessary. Losses in money due to over or under estimating load growth are practically eliminated because the expenditures more nearly approximate the load growth curve. The substations and copper are added when and where the load comes. Cases have been roughly analyzed where the new money required for the network system, instead of building a new substation, reduced the first year's expenditures from approximately (a) $500,000 to $250,000, (b) $380,000 to $208,000, and (c) $270,000 to $180,000. To be sure, these figures are the extreme and were found on systems where expensive substations and underground feeders are the rule, but nevertheless they indicate the network possibilities.

The network inherently avoids the concentration of large amounts of short-circuit kva. by the use of smaller transformer sizes and the

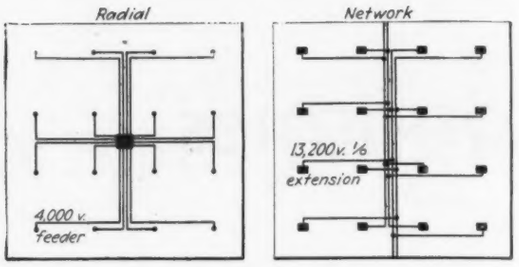


Substitution of 1,500-kva. network vaults for radial substation eliminates heavy feeders



Network formed by interconnecting existing radial mains

No more than four wires are required on one street. The other branches and distribution transformers remain undisturbed.



Cost comparisons of radial and network systems are simple

Radial cost involves one substation plus 4,000-volt feeders; network cost involves sixteen substations plus extra transmission laterals.

effective use of the circuit impedance. The values of short-circuit kva. at a given voltage depend upon the spacing of the transformers more than on the system capacity. The following table indicates the relation between substation spacing, short-circuit kva. and load density at infinite extension:

Spacing, Miles	Short-Circuit Kva.	Load Density, Kva. per Square-Mile
1½	71,000	535
1	88,000	1,200
½	140,000	4,800
¼	220,000	19,200

Thus for 36 times the load growth the short-circuit kva. is increased only three times. So, then, one breaker having 220,000 kva. interrupting capacity will be suitable for the life of the network and independent of system capacity. No obsolescence of circuit breakers is then incurred because of insufficient interrupting capacity.

The medium-voltage network can be applied on such an extensive scale (much more so than the 120/208-volt network) as to permit maximum benefits from the application of the synchronized-at-the-load principles. An extensive application of synchronization at the network is expected to simplify generating station arrangements by the reduction of buses and energy concentrations.

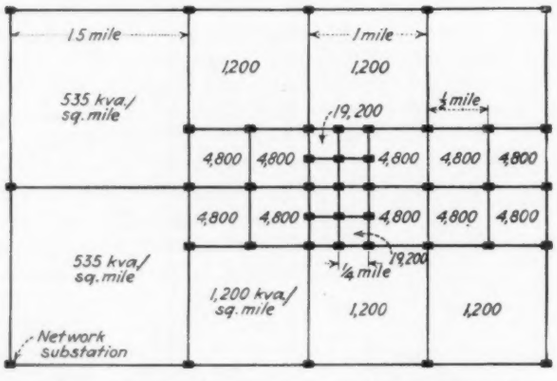
It is anticipated by some that before many years direct-current transmission will be an actuality with further simplification and economy. Alternating-current distribution is expected to continue. The medium-voltage network is the best form of an a.c. distribution system to receive energy from both alternating- and direct-current transmission when and if that becomes actual.

The network system will simplify to a high degree the relaying of the complete system when it becomes large enough to influence the transmission and generation layout. There are three types of protection required, namely, overload, reverse-power overload and bus differential. Plain overload protection is provided for all breakers connected in the network mains. These relays have the inverse time characteristic and, therefore, all may be set exactly alike by taking advantage of the substantial excess of current in the faulty main over the adjacent mains supplying current to the fault.

The transformer and transmission lines are protected as a unit by the well-known overload, reverse-power combination. The well-known bus differential scheme would be adequate for clearing the faulty station bus from the system without the interruption of any load.

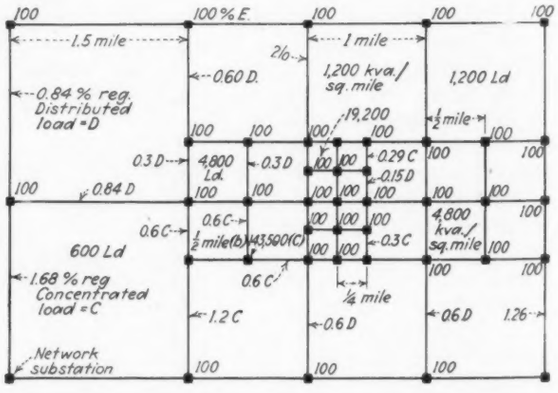
The network requires no more than four primary conductors on any one street.

The usual number of feeders radiating from substations are eliminated and thereby eliminate larger conductors than size No. 2/0 and all underground con-



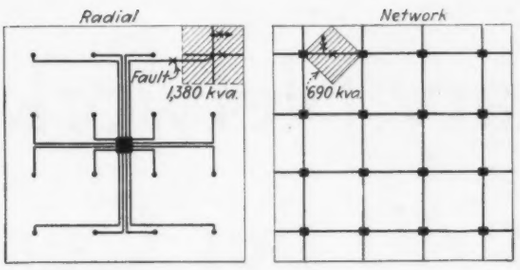
Network is adequate for wide range of load densities

A uniform system is built up by the addition of standardized units.



Ideal voltage afforded economically by network

Voltage difficulties on the primary disappear for 2 per cent range is so narrow as to be almost perfect.



Faults affect small area in network

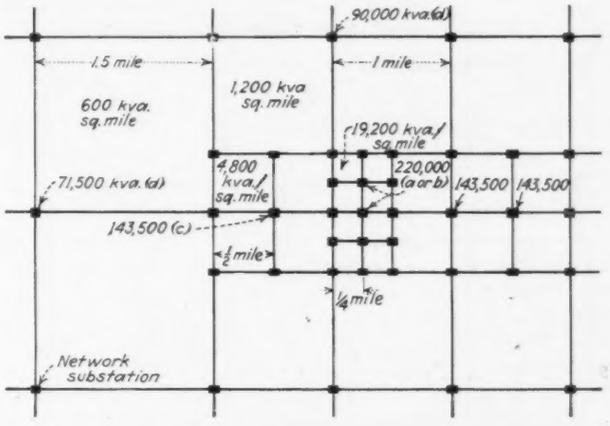
The network interrupts about one-half as much load as a radial 4,000-volt feeder and has fewer interruptions besides, because the feeders are eliminated.

struction otherwise required by the large number of radial feeders. Many territories are now so covered with copper that a network could be formed and many pounds of copper removed. The additional mileage of transmission required is very easily and economically provided by aerial cable installations. The network might well be overhead, with underground secondary distribution where this is desirable.

The network permits a degree of standardization never before anticipated with other methods. It becomes entirely possible to standardize on one size transformer with the variations only in the winding. The load ratio control may be standardized. Oil circuit breakers may be standardized in one voltage, one ampere rating, one interrupting rating, one mechanism. Finally, all equipment may be combined in one unit structure, including relays and metering. Such a network substation, factory assembled, reduces the utility companies' work to the process of building the vault and running the circuits to and from the vault. Thus the engineering, construction and accounting organization are reduced. Purchasing is simplified by eliminating a large number of propositions for separate purchase. Costs are more accurately known because the unit substation purchase price is definite and constitutes the largest cost. Deliveries become shorter and permit timing so as to transport direct from the car to the vault, thus reducing storage facilities.

The manufacturer is enabled to make one unit in quantities far in excess of present varieties. The scales of equipment approximate very closely the load growth curves of the industry. This enables the manufacturer to be reasonably sure of his market and make definite plans for improved manufacturing facilities to reduce costs. Engineering talent and factory workmanship concentrated on a unit results in a better product.

The simplicity of the network system does not leave much room for individuals' ideas, with all their varieties, to take precedence and offset the benefits of standardization. Standardization does not mean that no changes in the product will be made, but it does mean they are made in an orderly, systematic and economic manner, affecting all equipments alike.



Network short-circuit currents increase slower than increase in load density

A 250,000-kva. breaker is easily and economically standardized for all densities; therefore, no obsolescence.

Sufficient study has been made to indicate that the network principle can be applied to the 4,000-4,600-volt distribution level just as it has been applied to the 120-208 distribution level. A very great possibility exists for the application of the principle to the higher voltage levels. In the 4,000-4,600-volt level the network principle permits:

(a) Elimination of large substations, with consequent heavy investments in real estate, buildings and multiple-radial feeders.

(b) Use of, say, 1,500-kva. transformers and 250,000-kva. oil breakers exclusively by the industry, thus permitting mass production of this equipment.

(c) Use of a compact and complete substation, so to speak, of 1,500 kva., with self-contained equipment that can be purchased and used as a unit and located where needed. A vault for $3,000-$5,000 or a small fenced area is the only investment required for the substation site.

(d) Use of only four standard conductors on all streets in the network area.

(e) Use of existing radial overhead systems to make a network at a minimum cost.

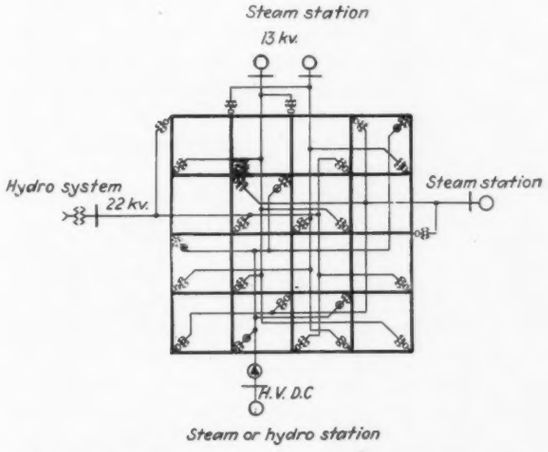
(f) Use of standard measuring and protective equipment.

(g) Elimination of detailed engineering for system additions and extensions.

(h) Giving of maximum service with maximum voltage regulation at a minimum cost.

(i) Development of a system that, so far as can be predicted, will fit best into the higher and lower voltage level systems of the future and the new developments expected in the art.

(j) Avoidance of obsolescence expense due to load growth rendering existing equipment inadequate.



Network adapted to variety of conditions

The medium-voltage network can be made sufficiently large to obtain the benefits of synchronized-at-the-load principle and at the same time be admirably adapted to d.c. transmission when that becomes practical on a large scale.

Pittsburgh Primary Network Saves 40 per Cent*

Economy in copper, transformers, circuit breakers and system losses.

Long-range planning less imperative.

Better regulation inherent in the network system.

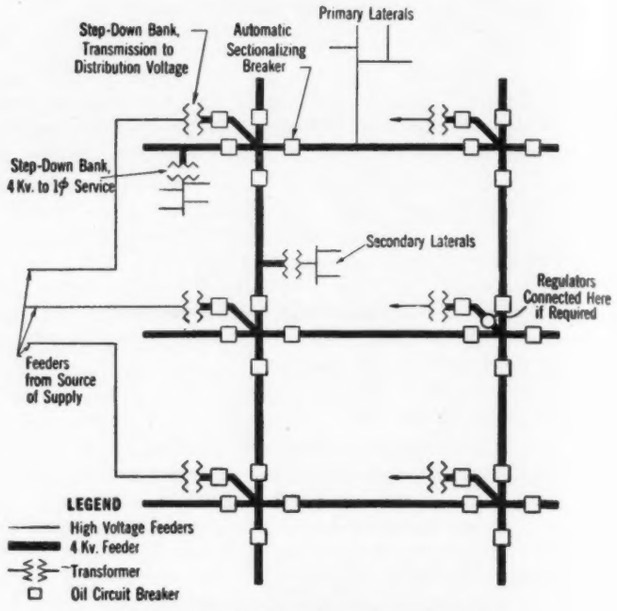
THERE are three elements in the primary network scheme: (a) the transmission feeders from the source of supply, (b) the transformers and switches and (c) the primary mains. Compared with the radial scheme the elements are the same except that the primary feeders have been eliminated. This feature, however, is only one of the items which permit a saving in initial cost over the radial system.

The initial study of a primary network was made for a section of Pittsburgh known as Squirrel Hill. This section embraces residences principally. There are a few apartment houses, a small business district, but no manufacturing load. The area comprises about 2.0 square miles with a winter peak of 4,200 kva., the load density being 2,100 kva. per square mile. This area is at present fed by circuits from two adjacent distribution areas, Schenley and East End substations, and was chosen for the initial economic study—first, because the area had relatively definite boundaries, with no existing substation within its limits, and, second, the growth of load indicated extension of existing radial system or adoption of a new system. Three transmission feeders are available within the area.

Estimates for the scheme of extension of a radial system are based on the standard practice for the Pittsburgh district. The substation proposed is a semi-outdoor type, 22/4 kv., full automatic, similar to those used on the Duquesne Light Company system.

Initial installation would consist of two 4,000-kva. transformer banks, a 22-kv. tie breaker, three 300-amp., 4-kv. regulated feeders and other necessary equipment. The building would provide space for an ultimate of two 6,000-kva. transformer banks and five 300-amp. regulated feeders. Primary feeders would be run in existing duct lines to their feeding points with sectionalizing switches as indicated.

The primary network includes the same area as covered by the radial system and the transformer and switching units, of submersible type, are to be in underground vaults located in the street.



Scheme of Pittsburgh network

Transformers of 1,500 kva. distributed over area and served by multiplicity of feeders. Regulators between transformer breaker and main protection breakers. If required.

Transformers are 1,500-kva., 22/4-kv. subway type with four 2½ per cent taps below and two 2½ per cent taps above on the high-voltage side and a three-position, oil-immersed, disconnecting and grounding switch on the 22-kv. side. The transformer oil circuit breaker is integral with the transformer. Lead-covered cable is used for all 4-kv. work in the vault.

The oil circuit breakers are 7,500 volt, 600 amp., having a rupturing capacity of 14,000 amp. 2 OCO at 4,000 volts. They will be arranged to reclose once on a fault, the breakers at each end closing at different times, so that the equivalent of two reclosings is obtained. The breaker with its control mechanism and relays will be mounted in a submersible type box equipped with wiping sleeves for lead cable.

Comparative costs of radial and primary network schemes are shown in Table I. The operating capacity of each scheme is 7,500 kva. If the cost units per kva. of capacity available for the radial scheme wth substation is represented as 100 per cent, a corresponding cost of the primary network is 56 per cent, or, as expressed in the table, the radial system is 78 per cent more costly than

**Abstracted from A.I.E.E. paper by R. M. Stanley and C. T. Sinclair at Pittsburgh, March 11.*

the network. If system voltage variation permits, regulators will, of course, be omitted in the network scheme because of the better inherent regulation due to the network. Primary feeder and duct costs are common to both schemes and are omitted from the comparison.

It was decided to make a similar study of the Verona-Oakmont district, which is located about 10 miles northeast of Pittsburgh. The area covered is 4.7 square miles, with a load of 2,000 kva. Load density is 425 kva. per square mile. The area is residential and light commercial load is supplied at present at 2,300 volts; the load in this area has only recently grown to an amount to justify a changeover to 4,000 volts. The present substation is to be abandoned for distribution purposes and the area converted to 4 kv.

For a radial system a new substation rated at 3,750 kva. and having two 3,000-kva. transformer banks was proposed. Two 4,000-volt regulated feeders are planned.

In the primary network three 1,500-kva. transformer points are planned. With one feeder out of service the capacity is 3,750 kva. based upon 25 per cent overload on the remaining transformers. The cost estimates are shown in Table II.

The network scheme has been estimated in three ways: (a) All equipment in underground vaults, (b) equipment in small buildings above ground, (c) outdoor installation (equipment above ground on concrete pads). Calling method (c) 100 per cent, we find that the radial scheme is 35 per cent more costly, with the building type installation and the underground vault at 7 and 18 per cent more costly respectively than the outdoor transformer installation. In areas of this type vaults will not ordinarily be necessary.

It was decided that one of each of the above types of installation be used in this initial primary network to form the three transformer points proposed for this area.

When the primary network was first considered no scheme for protection had been studied and it was felt that it would require a complicated combination of relays or the possible development of a new relay, but when the matter was investigated it was found that a very simple protection scheme could be used which would lend itself to ready expansion without the necessity of changing relay settings.

Table I—Squirrel Hill Cost Comparison

Initial Step

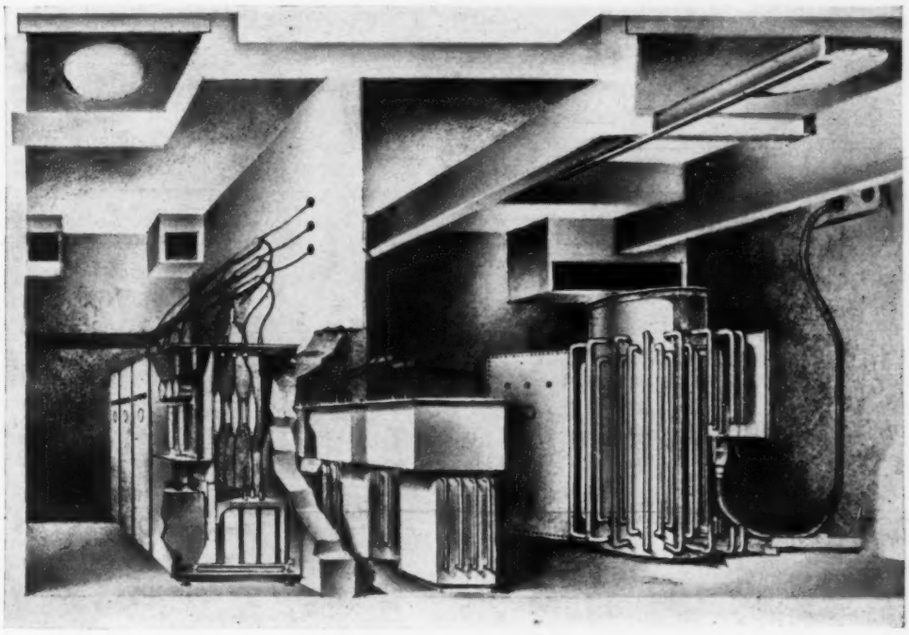
Load density 2,100 kva. per square mile

	Radial, Kva.	Network, Kva.
Load	4,200	4,200
Transformer capacity installed	8,000	9,000
Transformer capacity with spare capacity out of service	5,000	7,500
	Costs in per Cent	
Real estate	18	....
Substations	21	26.7
Electrical equipment	67	56
Transmission	1.2	1.5
Distribution	18.4	3.4
Ducts	4.7	10.8
Changes in 4-kv. feeders and mains	....	1.1
Total initial step	130	100
Second Step		
	Kva.	Kva.
Load	7,500	7,500
Transformer capacity installed	12,000	9,000
Transformer capacity with spare capacity out of service	7,500	7,500
	Costs in per Cent	
Substation increase	28	None
Distribution increase	20.5	None
Total second step	178	100

Note: Radial system (initial step) will have two 4,000-kva., three-phase transformers. With one out of service, the other will carry 25 per cent overload through peak or 5,000 kva., which is satisfactory for initial step and allowing for growth.

Network will have six 1,500-kva., three-phase banks and when one transmission line goes out, two 1,500 kva. banks go out also, leaving 6,000 kva. in service, which, with 25 per cent overload capacity, gives 7,500 kva. capacity to carry 4,200 kva. initial load.

A network relay similar to the one used on the low-voltage a.-c. network will be used to protect the transformer bank breakers. This relay would open the breaker on any type of high-tension fault, and also if the supply line is de-energized the magnetizing current for the bank in combination with the charging current of the line will be sufficient to open the breaker. It is also possible with this relay to have the breaker close when the high-tension line is re-energized. Therefore, the type of protection used on this breaker will be identical to that of the low-voltage network protector. In addition to this protection, consideration is being given to tripping this breaker by means of a contact-making thermometer placed on the transformer. In case of excessive overload which would be likely to damage the transformer, the



Barrier principle employed in vaults

In one compartment is the transformer and integral oil circuit breaker; 22-kv. cable is brought in from ducts in the street to the pothead on the transformer. From the oil circuit breaker, connected directly to the 4-kv. transformer leads, single-conductor, 4-kv. lead cable connects to the regulators. From these regulators 4-kv. cables are carried to oil circuit breakers in the other compartment, and from these breakers the cable is carried to potheads on poles, where connections are made to street mains. Size of vault, 30x12x13 ft. high.

thermometer when it reaches a predetermined value would energize the trip circuit, thus disconnecting the transformer from its load. This might be advisable in the event that two high-tension feeders should be out of service during a peak-load period, but would permit the one remaining bank to carry the load for as long a period as possible without damaging the transformer. In the majority of cases relief could probably be given this one unit before the temperature would reach the tripping value. Under this scheme no other overload protection would be used for the transformer breaker.

Bus differential protection will be used at each transformer installation to protect the bus within the intersection so that any type of fault will open all the breakers and lock them open. The overload relay for this protection will be installed in the transformer breaker cubicle.

Two schemes for tie main protection

A detailed study has been made to determine the type of protection best suited to protect all tie mains. All breakers are arranged for automatic reclosing with the breakers on each end of a main set to close at different intervals, so that the main is re-energized two times. If a breaker on the faulty main closes and again opens, it is locked out and no further operations are possible.

Two schemes have been worked out which will give adequate protection, namely: (1) Overload with definite time setting and (2) overload with inverse time characteristic:

1. *Overload with Definite Time Setting*—In this scheme the relays are set to operate at 150 to 200 per cent of transformer's full load current, namely, 300 to 400 amp. The time settings are staggered so that a breaker on one end of a main will open in 0.6 second and on the other end in 1.1 seconds. This scheme has one disadvantage—that breakers other than those connected to the faulty main open, although there is no interruption to service on other mains, since none of the breakers set at 1.1 seconds have sufficient current after the 0.6-second breakers open to operate except the one directly connected to the fault.

2. *Overload with Inverse Time Characteristic*—This scheme employs a relay with a greater inverse time characteristic than is normally used. With a 400/5 current transformer and the 4-amp. relay setting the relay will operate at 480 amp. in nine seconds and will operate on a current as low as 320 amp., although the time would not be accurate. In this scheme only the two breakers connected to the faulty line operate. However, if corner transformers are installed in which tie mains are run in only two directions, proper selection cannot be made when this particular transformer is out of service. In general, it may not be advisable to use this design, but rather run a third main to some adjacent intersection. This scheme appeared to have certain advantages over scheme (1) and was adopted.

Short-circuit studies were made of the network layout for three-phase and phase-to-ground faults at all locations along the tie mains, with all transmission feeders in service and with each one out to determine the definite requirements of a relay.

Similar studies have been made on layouts using various numbers of transformers and with various length mains, and in all cases the results are comparable to the Verona-Oakmont study, so it is believed that no trouble should be experienced in relaying the primary network, particularly if two-way feed transformer installations can be eliminated.

Table II—Verona-Oakmont Cost Comparison

Load density 425 kva. per square mile

	Radial, Kva.	Underground Vault, Kva.	Network Building, Kva.	Outdoor, Kva.
Load	2,000	2,000	2,000	2,000
Proposed inst. capacity	6,000	4,500	4,500	4,500
Operating capacity*	3,750	3,750	3,750	3,750
		Costs in per Cent		
Real estate	17.0	....	2.8	2.8
Substation building or vault	4.2	24.5	13.0	5.8
Equipment	95.0	71.0	66.3	66.3
Transmission	2.5	3.3	4.4	4.4
Distribution	1.6	13.2	13.2	13.2
Duct connections	14.5	5.7	7.5	7.5
Total	135	118	107	100

*Based on 125 per cent load on transformers for five hours in case of feeder or transformer failure.
Note: Cost of regulators included in above estimates.

The transformer will be 1,500-kva. three-phase subway type, 22,200/4,000-volt Y, with four $2\frac{1}{2}$ per cent taps below and two $2\frac{1}{2}$ per cent taps above 22,000 volts, and to have an inherent impedance of 10 per cent. The 22,000-volt cable supplying the transformer will terminate in an oil-tight pothead with a three-position switch, so that the cable may be either disconnected from the transformer, connected or grounded, and is protected by an interlocking mechanism so that if the transformer is energized from either side it will not be possible to operate the switch. This pothead or oil-tight chamber is mounted on the transformer as an integral part of the case. On the 4,000-volt side the leads will be brought out through oil-tight bushings so constructed that an oil circuit breaker cubicle can be bolted to the transformer case, making a water-tight connection.

The oil circuit breakers are 600 amp., 7,500 volts and will rupture 14,000 amp. with the standard duty cycle. They are mounted on a small truck and placed in a small subway type cubicle, in which all relaying equipment, current transformers, motor-operated mechanism, etc., are mounted. Space is not allowed for inspection of the breakers while in the cubicle, but they are easily disconnected and rolled out. Each unit is self-contained, and at the time of installation it is only necessary to connect the cables to the wiping sleeves.

Regulation

The percentage regulation for the network is very low, so that in general it does not appear necessary to use regulators unless there is considerable variation in the supply voltage of the transmission lines. To prevent the problems which arise with normal parallel regulator operation it will be necessary to control each intersection by a contact-making voltmeter set so that each intersection will maintain the same constant voltage.

Regulators will be the standard single-phase, oil-immersed type, 200 amp., 2,300 volt, 5 per cent buck or boost and equipment with wiping sleeves. The motor, control and transformer for the motor circuit will be mounted in a box on the side of the regulator, so that the unit is complete in itself, with all connections gasketed to make it subway type.

The primary network offers the following advantages over the usual radial system:

1. The radial system is 78 per cent more costly than the network. Or, expressing it in the reverse order, the network costs about 56 per cent of the radial system now in use. Even under adverse conditions, such as in areas

of load densities as low as 425 kva. per square mile, the cost runs as much as 35 per cent higher for the radial system.

2. Reduced copper sizes are possible on the mains because of the smaller currents and shorter distances of feed, the results of the network principle.

3. Short-circuit studies of the two areas studied and of theoretical systems indicates that the oil circuit breakers can be materially smaller than for the corresponding radial system.

4. The network principle results in better regulation than on the radial system. Any radial system inherently has considerable voltage variation which regulators cannot compensate. It is believed from a theoretical voltage analysis made that a very uniform voltage will be obtained on the network.

5. Transformer units (transformers, switches, regulators, if used, and auxiliary equipment) can be manufactured in units, stocked if necessary, and installed when required.

6. The radial system requires a substation and distribution system to be built well in advance of the load growth. Long-range estimates are necessary for load growth, in both direction and magnitude. In the primary network transformer units are installed where and when needed. Only as the load appears is the system expanded. Long-range predictions are unnecessary. Investment is not made in large steps far in advance of the load growth.

7. The total losses in the primary network are less than for the radial system. One item of saving, for example, is the complete elimination of feeder losses, as there are no feeders.

8. With the designs considered, each section will have a capacity of 600-700 kva. The radial circuit has a capacity of 2,100 kva. A failure in the case of the primary network, therefore, involves less than one-third the load of the radial system.

9. The high-tension cables run directly to the network transformers and hence no breakers are needed.

▼ ▼ ▼

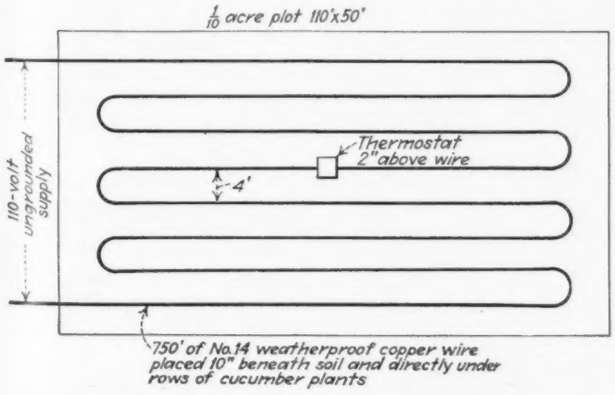
Electrically Heated Plot Doubles Garden Yield

Experiments with a 1/10th-acre electrically heated cucumber plot near Los Angeles proved so satisfactory that a large field has been opened for electric heat as a forcing agent for out-of-season truck crop growing. Two similar plots were used in the experiment, one maintained at 70 deg. by wires placed beneath the soil and the other as a check plot. Forty-one days were required from planting to maturity on the heated plot, which was twenty days before cucumbers on the unheated plot were of marketable size. In other words, the growing time was cut in half. Moreover, the yield from the heated plot was double that of the other and brought $300, as against $150, and the crop was what is called "choice."

The installation cost was about $100 and the bill for current $40, so that the experiment more than paid for itself in one season. The method of wiring the plot is shown in the accompanying sketch. Iron, aluminum, copper and nichrome bare wire all proved unsuccessful due to rapid oxidation. No. 14 weatherproof wire was found most suitable. It is expected this will last two seasons. Upon the gardener's recommendation a temperature of 70 deg. was thermostatically maintained. This is probably higher than necessary and also it appears that the last two weeks of heating could have been eliminated.

While forced growing of this kind is highly successful, not only for vegetables but flowers as well, it must not be overlooked that general adoption in the same locality would largely destroy the advantages of an early crop. The experiment was made by the Southern California Edison Company, Ltd., under the direction of G. N. Hawley, industrial heating specialist.

Average vine on unheated and heated plot


1/10 acre plot 110'x50'
Thermostat 2" above wire
4'
110-ft. underground supply
750' of No.14 weatherproof copper wire placed 10" beneath soil and directly under rows of cucumber plants

Essential data on electrically heated garden plot

producing twice the yield in half the time

Current, amp.	50	Cost of installation	$100
Demand, kw.	5	Growing time	½
Consumption, kw.-hr.	2,400	Yield	Double
Power bill	$40		

4-Kv. Network Saves 20 per Cent

By A. H. SWEETNAM

Superintendent Electrical Engineering Department, Edison Electric Illuminating Company of Boston

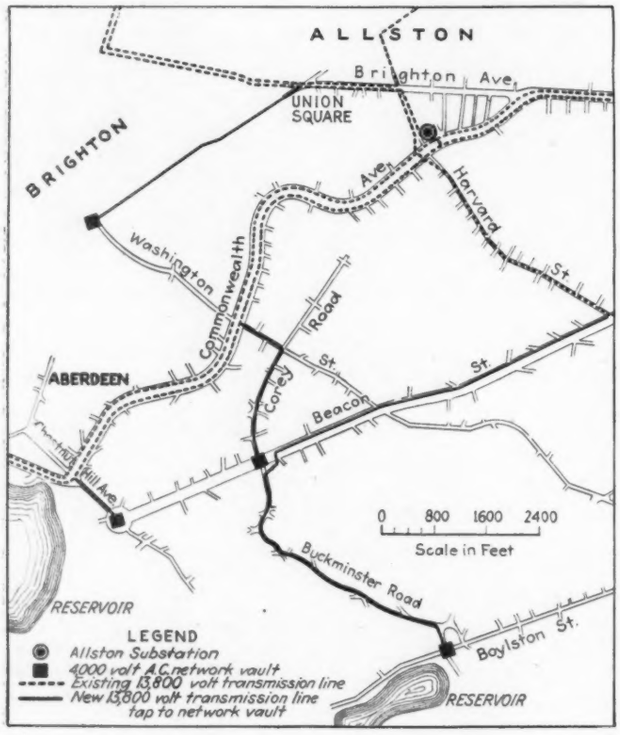
IN 1930 THE Edison Electric Illuminating Company of Boston faced the problem of relieving its Allston substation of about 3,400 kva. of load before the fall of 1931. The capacity of this substation with the largest transformer bank out of service was 13,600 kva. and the estimated peak next fall is 17,000 kva. for this district. A study showed that by building a new substation in Brookline with short 4,000-volt radial feeders Allston could be relieved, and it was proposed to install initially two 7,500-kva. transformer banks with space for future additions, tapping two existing transmission lines and following the usual procedure in such problems. Preliminary studies of medium-voltage network possibilities were instituted, however, with the aid of D. K. Blake of the General Electric Company and these indicated a sufficient saving in initial and ultimate investment by the use of a 4,000-volt alternating-current network, besides other advantages, to warrant its adoption.

Careful estimates of the relative costs of supplying the area by such a network and by a new substation with radial distribution showed that the capital investment would be reduced at least 20 per cent by the use of the network system. Even greater savings were shown for the initial installation. The reduction in the ultimate investment did not include even greater savings in favor of the network obtained by being able to add relatively small increments of capacity, thus closely following the requirements of the load as against the large increment additions inherent in the development of a substation.

The particular problem was to create the new system of distribution from the existing 4,000-volt radial circuits in the area which would have been supplied from the new substation. Three major aspects had to be considered: (1) Location and equipment of the vaults; (2) transmission line extensions to the vaults; (3) cutting over the existing radial circuits to form a four-wire network between vaults.

In the substation study it was planned to take over about 4,500 kva. of load, and as the network was to supply the same area, it remained only to decide upon the most advantageous size of transformer. This was settled upon as 1,500 kva., taking into account the local situation, the larger aspects of network applications and the manufacturing, installation, maintenance and stocking aspects of the problem. Four vault locations were therefore provided, as it was necessary to install sufficient transformer capacity to serve the entire network load with one transformer and its associated transmission line out of service.

Choice of vault locations was influenced by the desirability of locating near a load center in order to reduce voltage drop and maintain good regulation, of locating



Tentative location of Brookline and Brighton network vaults with tap connections to Edison transmission lines

Adoption of 4,000-volt network system avoids necessity of building substation.

Investment in unused capacity reduced.

Graphic record of load growth indicates area in which additional capacity is required.

Economical development now possible on increment basis.

Reliability of service improved and costs reduced.

No wire sizes had to be increased in adapting existing radials to 4,000-kva. network service.

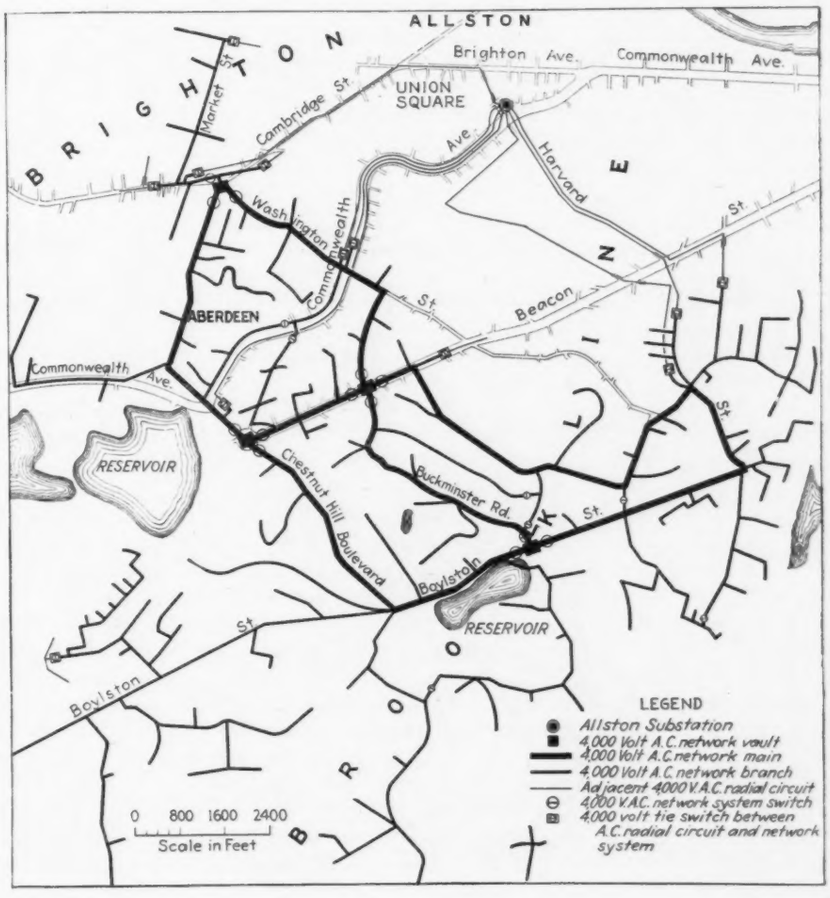
near an existing transmission line in order to make taps to transformers as short as possible and of locating at street intersections having existing four-wire, 4,000-volt, commercial circuits feeding in several directions, in order to minimize the installation of new 4,000-volt connections.

Due to the foresight of the manufacturer, we found very complete data available on the proposed apparatus for this new system. Much development work had already been done and it only remained for us to suggest such changes as would better adapt the equpiment to local conditions.

Each vault will contain one 1,500-kva., three-phase, self-cooled transformer rated at 13,800 volts primary and 4,330 volts secondary, with one full-capacity primary tap for 5 per cent above normal brought out to a ratio adjuster. The transformer will also have load ratio control, designed to change automatically the ratio in eight equal steps over a 10 per cent range, two steps being above the tap in use and six steps below. Provision will also be made for future blower equipment to increase the rating to 2,000 kva.

The Brookline and Brighton installations are based on the 4-kv. network scheme described on page 492 of this issue of ELECTRICAL WORLD, but do not utilize it completely as there is no present need for low-voltage alternating-current network service in this district. In each vault the transformer primary is connected through a three-position, oil-immersed, disconnecting switch to the transmission line tap, and the secondary side connects to a 4,000-volt bus through an automatic oil circuit breaker. The 4,000-volt network connections are taken off this bus through automatic reclosing oil circuit breakers and tie directly into the existing four-wire commercial circuits. In this way the four wires of existing radial circuits may be utilized to form four-wire ties or mains between vaults, thereby establishing a 4,000-volt, four-wire network fed at several points and capable of furnishing continuous service even with one transformer out.

In case of a transformer or transmission line failure, the transformer circuit breaker is designed to open on power reversal and disconnect the transformer from the 4,000-volt bus, leaving this energized from other vaults by the mains. The bus differential protection is designed to trip and lock out the transformer and all feeder breakers in case of a fault within the metal-clad unit. Automatic reclosing of the transformer breaker will be provided. Reclosing of this breaker takes place only after a time interval and if proper voltage and phase relations are established. All apparatus for vault service will be metal clad and floodproof. Primary and secondary transformer



Tentative vault locations and 4,000-volt network after building up from existing radial circuits

For simplicity, all except the vault sectionalizing switches have been omitted and only tie switches in the network and those ties to radial feeders from which load has been taken are shown. Lightning arresters are to be installed on all standpipe poles where the four-wire mains change from overhead to underground and on the longer overhead taps with underground main connections.

windings will be Y-connected, with 4-kv. neutral solidly grounded and the 13.8-kv. neutral arranged for either grounded or isolated operation.

To obtain operating data on the network there will be between each transformer secondary and the 4,000-volt bus three recording voltmeters, three single-phase watt-hour meters and three recording ammeters. The recording meters will all be equipped with motor-driven charts. For the purpose of determining the load on any individual feeder, it is proposed to install three recording ammeters provided with transfer features to enable them to be connected to any desired main.

4,000-volt, four-wire network set up

In the formation of this four-wire network between the transformer vaults the first step was to make a layout on a large scale map of Brookline and Brighton of the existing radial circuits in the area to be taken over, showing the number and size of all the underground or overhead conductors on each street, all existing switches in their normal operating position, all the connected transformers and their sizes, all the phase areas and all the demand loads in each phase area as obtained from our daily load readings.

From this circuit map it was easily seen just how much work would be necessary in order to cut this area clear of the existing radial feeders supplying it from the Allston substation and allow it to feed as a network from the four transformer vaults in the locations chosen. It was also possible to determine approximately the load that would normally be supplied by each vault, and thus make a calculation of the amount of load which it would be necessary to transfer over each network main in the event of any transformer being out of service.

In most cases there were existing four-wire mains between the locations which had been chosen for the vaults, and it was only necessary to cut these mains, extend them into a vault and connect them to a network oil circuit breaker. In a few cases there were three wires of a three-phase power circuit and two wires of a single-phase lighting circuit on the same street. These circuits were combined to form a four-wire main and the dead wire removed. In only one or two cases was it necessary to run any new wire or cable to complete a four-wire main, thereby reducing the street work involved in this changeover to an absolute minimum.

No wire sizes increased

In view of the fact that 1,500-kva. units are to be installed, which normally will be 75 per cent loaded, and as the four-wire mains will feed at least in three directions, the normal current that each conductor will be called upon to carry is only 60 amp. In the event of one transformer being out of service, the maximum possible current to be carried by any conductor would not be greater than 120 amp. Therefore it was not found necessary to increase the size of any existing wire or cable, for the smallest conductor encountered was No. 1/0 cable, and this has sufficient current carrying capacity for this load. It will not be necessary to overload any section of these mains, because before that condition can arise the existing transformers will have become overloaded, which will necessitate the installation of another transformer vault at a new load center. This will automatically reduce the load on the particular conductors involved.

It was necessary to do very little rephasing on the network because the single-phase loads on the existing radial circuits were already balanced between the three phases. As these circuits are to be taken over intact, the loads would automatically be balanced on the network. About the only place where it was found necessary to cut over transformers was where existing light and power circuits had been combined to form a four-wire main.

One important thing which had to be considered, however, was the possibility of outages to customers when these loads were cut over from the radial to the network system. In this day of oil burners, electric ranges, X-ray machines and other utilization devices this problem is serious, and because of the diversity of load it is sometimes very difficult to take even a portion of a circuit out of service during any time in the 24 hours without seriously affecting some customer. With this idea of outages in mind, additional sectionalizing and tie switches were installed to facilitate switching certain loads from one section to another, or even to take part of the load back upon an existing radial circuit if desired.

Advantages of the network system

Voltage regulation will be ideal due to the fact that vaults will be located at load centers and will be relatively close together. The use of voltage regulators, with their associated line drop compensators, contact-making voltmeters and other miscellaneous equipment for the individual feeders, will no longer be necessary, due to the provision for automatic tap changing under load in the transformer itself. It will no longer be necessary to regulate the voltage of each phase for a certain definite area, because in the network the voltage at any particular point is approximately the same for all phases.

All circuit breakers used in the network vaults are of ample rating to handle any short-circuit currents which may be developed by the network, up to an installation of capacity sufficient to supply load of a maximum density of 20,000 kva. per square mile. This applies only in the case of overhead network mains. Should any considerable portion of the network mains be installed under ground short-circuit currents may readily be kept within circuit breaker ratings by the installation at some point in the mains between vaults of low-capacity, subway-type, oil-immersed reactors. To those who are faced with the problem of keeping pace with the ever-increasing short-circuit duties on substation circuit breakers this feature of the network will have a particularly strong appeal.

The addition of load to the network will involve much less rebuilding than is now required. On a radial system the distribution transformers must be connected to the phase whose voltage is regulated for that particular area in which they are to be installed in order that the customers receive standard voltage. In case this phase is already heavily loaded, it may be necessary to do considerable rephasing in order to keep the loads properly balanced. In the case of the network, however, it will only be necessary to determine from the recording ammeter readings the lightest loaded phase in that area where the increase is desired and connect the transformer to that phase, with the assurance that it will receive its proper voltage. This may not strictly apply to network branches where additional phase wires on the branches may be required to maintain proper balance. In this

system, therefore, the need for rephasing will be much reduced and new loads may be added as desired without unbalancing the circuit or affecting the voltage.

Load growth easily handled

When a radial circuit becomes overloaded it is usually necessary to install a new circuit from an existing substation to provide for its relief. This involves the installation of new regulators and circuit equipment at the station and the installation of feeder cable out to some point where a portion of the overloaded circuit may be taken over onto the new feeder. After this load has been taken over it is necessary to rephase both circuits and to adjust the line drop compensators in order to provide standard voltage in the new phase areas. When a network becomes loaded to such an extent that, with one transmission line and its associated transformers out of service, the remaining units no longer have sufficient capacity to supply the load, it is only necessary to install another transformer unit at some new load center, extend a transmission line to this new location, cut the existing four-wire street mains, extend them into the vault and connect them to the corresponding network oil circuit breakers. In this manner the growth of load on an existing network can be provided for with no 4,000-volt street work other than the extension of the four-wire mains into the new vault, together with minor cutovers and rephasing. Service outages are thereby materially reduced.

Extension of this network into adjacent territory is also very easily accomplished and is subject to the same considerations that govern the original installation, namely, the selection of transformer vault locations, the extension of transmission lines to these locations, and the cutting over of the existing radial circuits to form four-wire mains between vaults.

From an operating standpoint, also, the network offers many decided advantages over the radial system. Better continuity of service is assured because each network main is supplied from at least two directions, and the loss of one of these sources of supply will cause no interruption to service. Any trouble on the network will take out only that portion between transformer vaults and will cause no interruption to service on the remainder of the network. This will tend to reduce service interruptions materially, because at the present time any trouble on an existing radial circuit automatically takes the whole circuit out of service.

As the necessary network equipment can be obtained as a unit, which will permit standardization, the result will be better equipment, quicker delivery and a lower price from the manufacturers. This will necessitate less engineering, purchasing and accounting work on the part of the operating company.

In the existing radial system there may be feeders of several circuits and possibly a set of distributors on the same street, or, in some cases, a single-phase and a three-phase circuit may parallel each other, so that in many places there may be considerable congestion of conductors, which materially increases the possibility of trouble. As the network consists of only one four-wire main, which supplies both single- and three-phase loads, no congestion of conductors occurs, thereby reducing the chances for trouble and consequently the maintenance work.

A study of the above factors shows quite definitely such a decided superiority of the network over the radial system of distribution with regard to economy, simplicity, continuity of service, voltage regulation, standardization of equipment, provision for load growth, etc., and adaptability to areas of any load density, that whenever it becomes necessary to make any extensive changes in the existing distribution system or plan a new system careful consideration should be given to the possibility of installing a 4,000-volt network.

▼ ▼ ▼

Allowable Fiber Stresses of Wood Poles Under Vertical and Transverse Loading

The American Standards Association has approved the following standard values for ultimate fiber stresses of wood poles as used in electrical line construction:

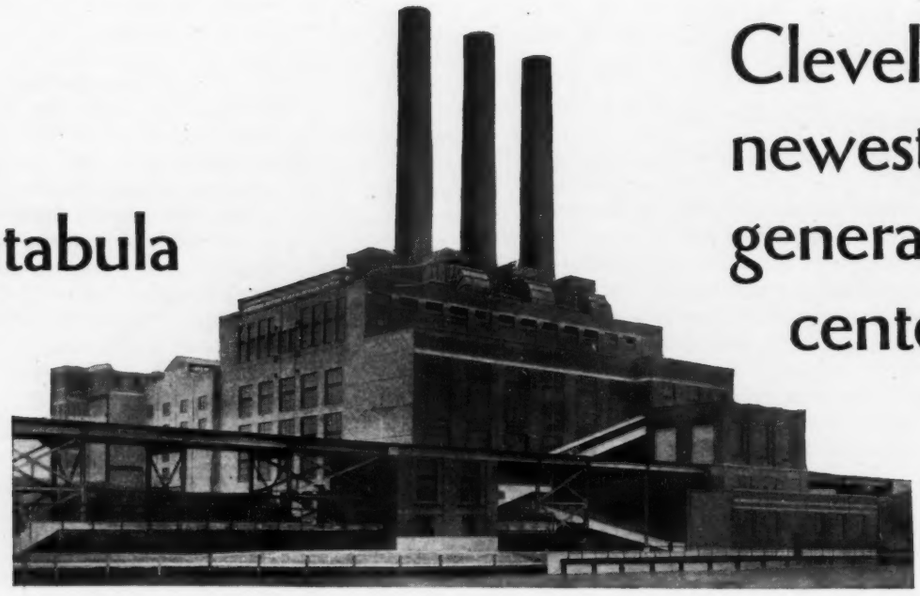
	Pounds per Square Inch
Northern white cedar	3,600
Western red cedar	5,600
Chestnut	6,000
Southern yellow pine (creosoted)	7,400

The value approved by the American Standards Association for Northern white cedar is the same as that already recognized in the code. The values for the three other woods are new and will supersede those heretofore in use.

A revision of Table XX containing the new values is given at the right and may be used in future applications of the National Electrical Safety Code.

In Pounds per Square Inch	When Installed									At Replacement				
	Treated Poles					Untreated Poles				Treated or Untreated Poles				
	For Ultimate Fiber Stress of—													
	7,400	6,000	5,600	5,000	3,600	6,000	5,600	5,000	3,600	7,400	6,000	5,600	5,000	3,600
At crossings:														
Poles in lines of one grade of construction throughout—														
Grade A	2,470	2,000	1,870	1,670	1,200	2,000	1,870	1,670	1,200	3,700	3,000	2,800	2,500	1,800
Grade B	3,700	3,000	2,800	2,500	1,800	3,000	2,800	2,500	1,800	5,550	4,500	4,200	3,750	2,700
Grade C	5,550	4,500	4,200	3,750	2,700	4,500	4,200	3,750	2,700	11,100	9,000	8,400	7,500	5,400
Poles in isolated sections of higher grade of construction in lines of a lower grade of construction—														
Grade A	2,470	2,000	1,870	1,670	1,200	1,500	1,400	1,250	900	3,700	3,000	2,800	2,500	1,800
Grade B	3,700	3,000	2,800	2,500	1,800	2,000	1,870	1,670	1,200	5,550	4,500	4,200	3,750	2,700
Grade C	5,550	4,500	4,200	3,750	2,700	3,600	3,360	3,000	2,160	11,100	9,000	8,400	7,500	5,400
Elsewhere than at crossings:														
Grade A	2,960	2,400	2,240	2,000	1,440	2,000	1,870	1,670	1,200	4,440	3,600	3,360	3,000	2,160
Grade B	4,440	3,600	3,360	3,000	2,160	3,000	2,800	2,500	1,800	7,400	6,000	5,600	5,000	3,600
Grade C	7,400	6,000	5,600	5,000	3,600	4,500	4,200	3,750	2,700	11,100	9,000	8,400	7,500	5,400

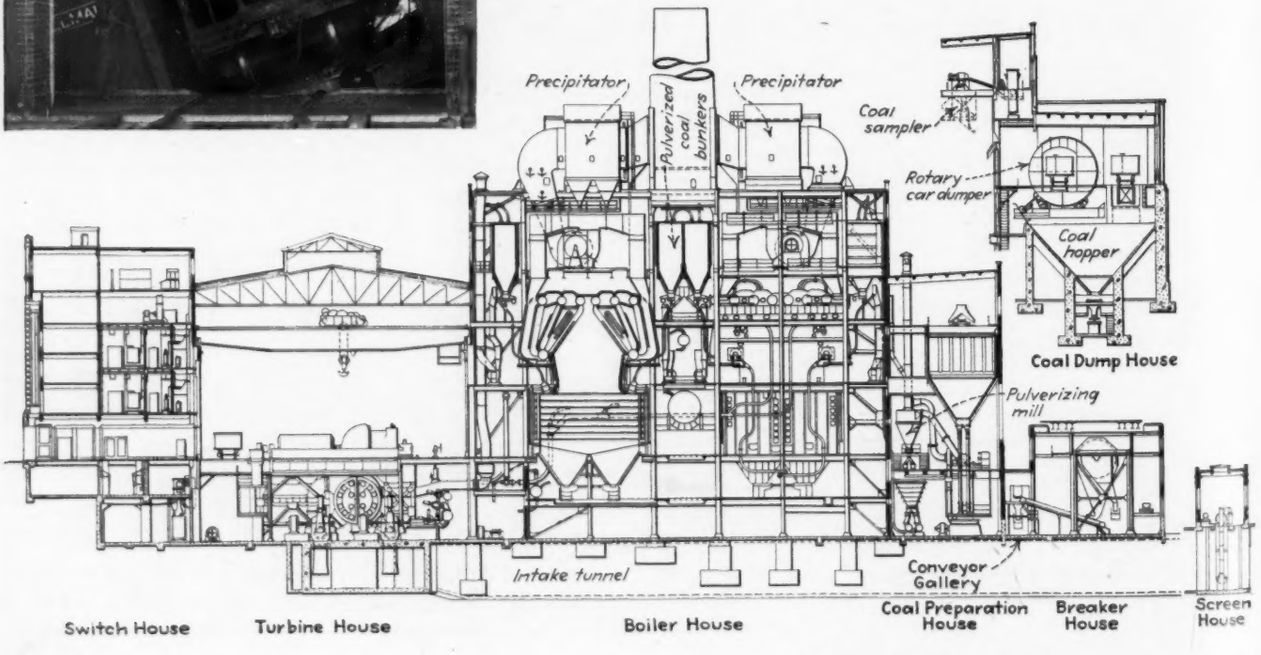
Ashtabula

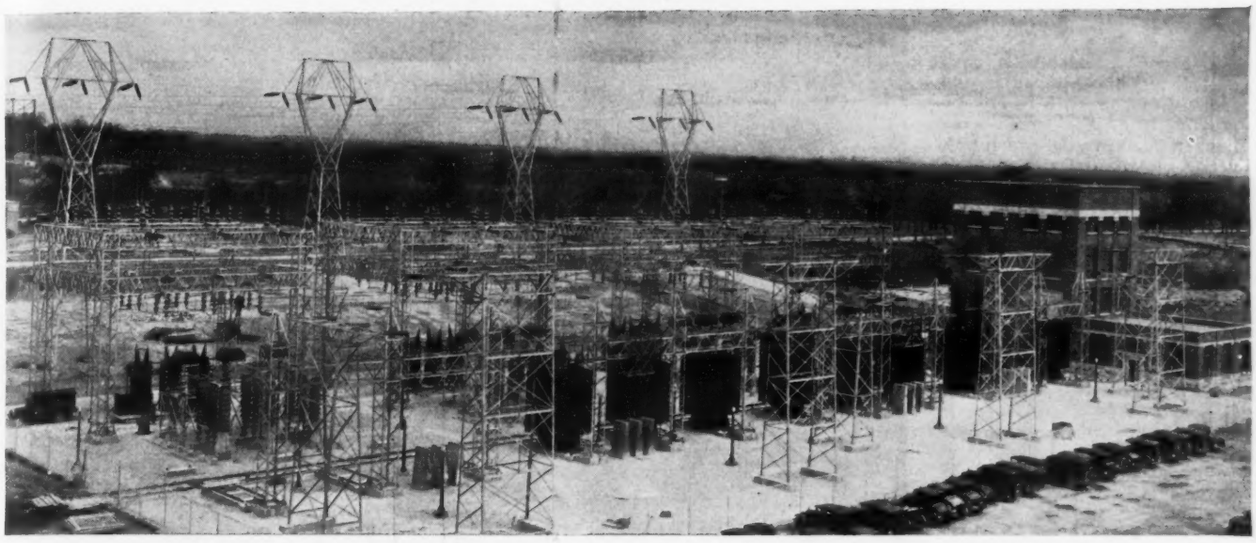


Cleveland's newest generating center

WITH Avon on the west, Lake Shore in the center and the new Ashtabula station on the east, the Cleveland Electric Illuminating Company has now a triad of major energy sources. Ashtabula went on the line in November, 1930, with three 50,000-kw. turbo-generators. Except for the increase of size of units from 35,000 kw., the new station is practically a design duplicate of Avon, which has proved itself an eminently satisfactory operator. Energy goes out from Ashtabula on 132-kv. lines, four south 8 miles to a 30,000-kva. substation and four west 53 miles to a 54,000-kva. substation.

Twenty coal cars can be dumped per hour here. Coal is received in standard railroad cars, which after being weighed are dumped into a large receiving hopper by this 52-ft. rotary car dumper. Provision is made also for unloading by hand. Leaving the receiver hopper, coal is carried by conveyor belt to a breaker, where it is reduced to 1¼ in. size. A by-pass is provided around the breaker for slack coal.



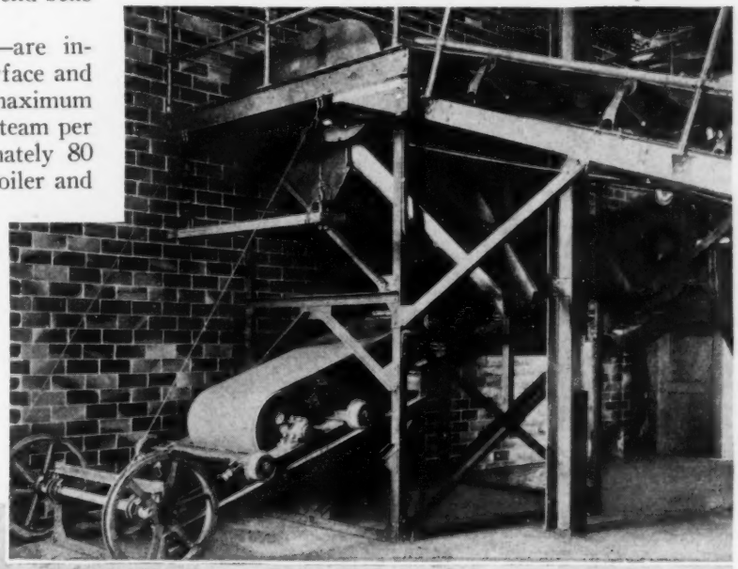


All high-tension switching is outdoors. For about one mile out of this outdoor switching station two ground wires are used, and from there on a single ground wire. Each tower carries two vertical No. 4/0 copper circuits.

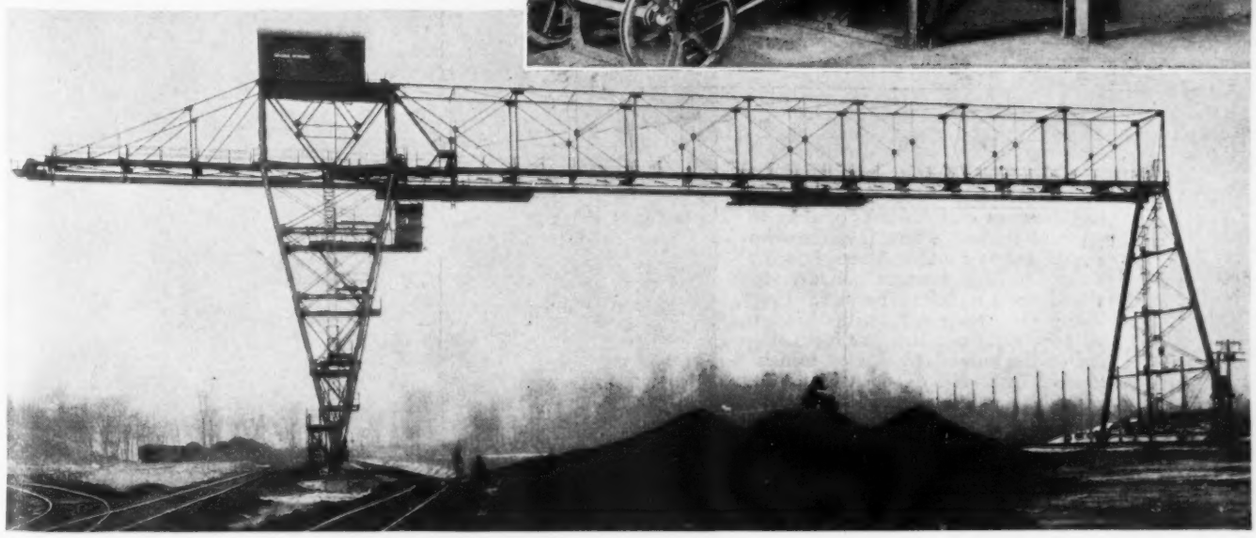
The turbo-generators have seventeen stages, operate on 375-lb. steam, 700-725 deg. F., and generate at 13,200 volts. High-pressure steam jets are provided in end bells for fire protection.

Six Stirling boilers—two to each turbine—are installed, each having 32,560 sq.ft. of heating surface and 23,232 sq.ft. of economizer surface. At maximum capacity each boiler can furnish 416,000 lb. of steam per hour, which is sufficient to maintain approximately 80 per cent full load on one of the main units. Boiler and turbine main valves are motor operated and controlled either locally or from a remote section.

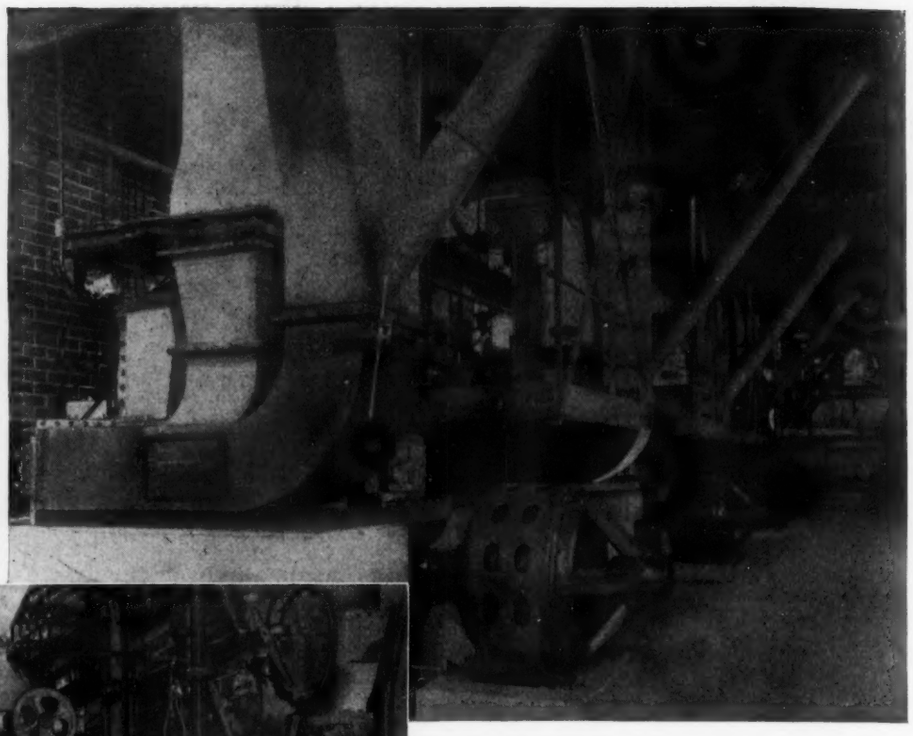
Magnetic separator removes tramp iron from coal. After passing the breaker, the coal is elevated by conveyor belt to the top of the preparation house, where it passes under an electric magnet and is transferred to the long distributor belt running the entire length of the building over the green coal bunkers. All coal-handling machinery is designed to handle 350 tons per hour.

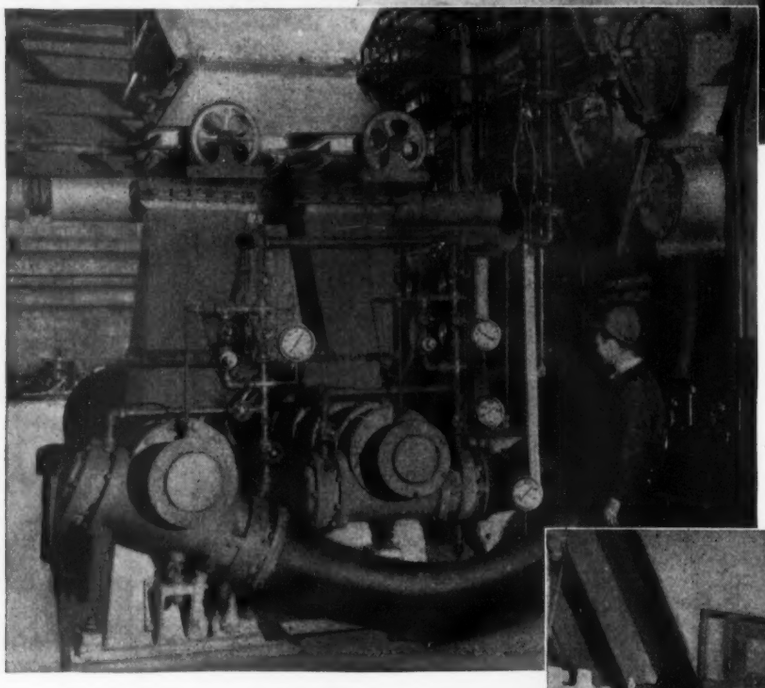


285-ft. bridge crane stores and rehandles coal. Provision has been made for storing 224,000 tons of coal on the company property. The bridge crane shown can handle from 200 to 300 or more tons per hour, according to operating conditions. Direct connection with coal fields to south is provided.

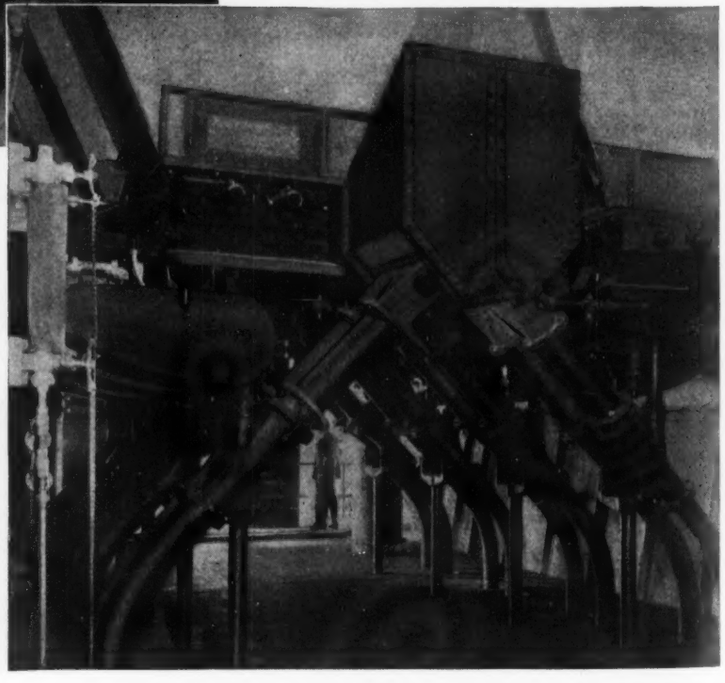


Six 15-ton impact mills with heated air blast pulverize the fuel. Crushed coal is fed by gravity from the green coal bunkers to the mills, which pulverize the fuel to a fineness of 65 per cent through a 200-mesh. The heater air blast reduces the moisture content to practically 3 per cent, keeping the mill maintenance down to a minimum and also increasing the capacity of the mill. The pulverized coal is removed from the mills by motor-driven exhausters and discharged into cyclone separators, whence it is conveyed by means of four 16-in. screw conveyors to the receiving bin. The screw conveyors have a total capacity of 60 tons an hour and the receiving bin a capacity of 16 tons.

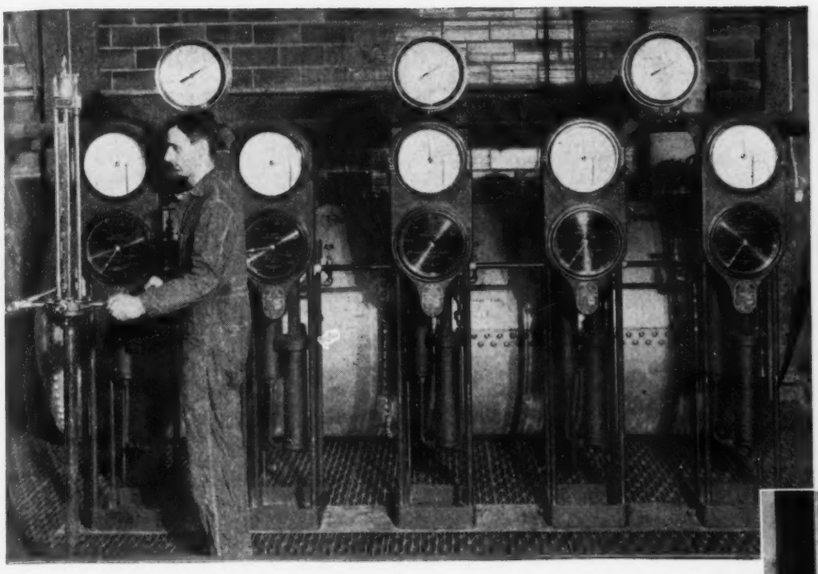




Two 100-ton-per-hour fuel transport pumps deliver powdered coal over boilers. These pumps, by means of a screw feed and compressed air, remove the coal from the receiving bin to the 90-ton pulverized fuel bunkers, situated above and in front of each firing side of the boilers. There are two bunkers for each boiler. The transport system consists principally of wrought iron pipe and valves for directing the fuel into the desired bunkers. Manual control and bin indicators are used in this cycle.

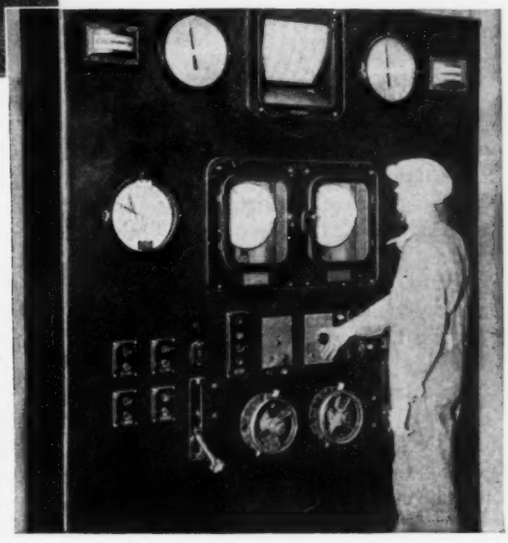


Sixteen feeders supply fantail burners in each furnace. From the pulverized fuel bunkers coal flows by gravity to the fuel feeders, where it mixes with the primary air and is blown into the boiler furnace through slightly inclined vertical fantail burners. Each boiler is equipped with sixteen burners, eight to a side, the fuel being fed to the burners by duplex feeders, four on each side, driven by 2½-3½-hp. variable speed d.c. motors.

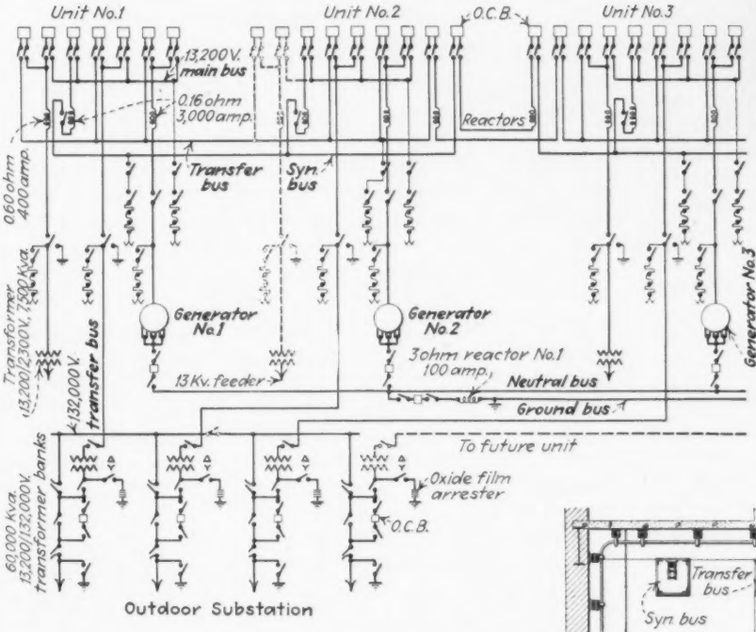


Venturi meters measure water flow to boilers. The three upper meters indicate water pressures and the two lower in the double panels indicate and record flow in thousands of pounds per hour.

Control for two boilers. Two boilers constitute an operating unit for one turbine.

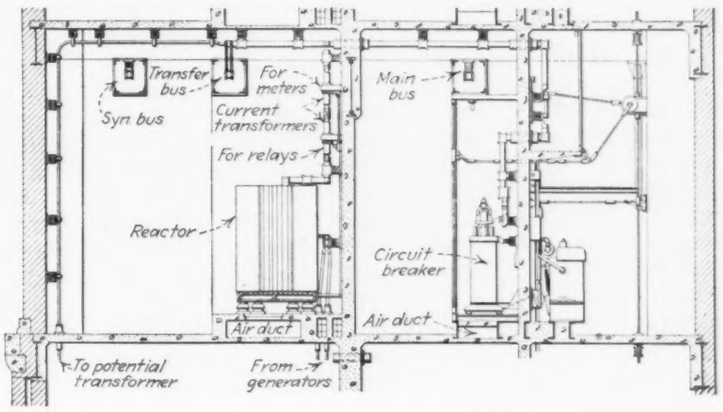


Generators, transformers and lines operated as unit by paralleling on low-tension side. Each of the three generating units supplies a bank of 60,000-kva. transformers, stepping up to 132 kv. The low-tension leads consist of four 1,500,000-circ.mil bronze-taped cables per phase, installed under ground in fiber conduit runs, a few hundred feet long. A gang-operated disconnecting switch is installed between the leads and the transformer. Breakers on the high-tension side are of the



Arrangement of breaker, disconnects and reactor for one phase of generator circuit. Each switch house wing will house the switching and reactor equipment for four generators. A separate floor is devoted to each phase, there being a separate section for each generator and its associated circuits. The sections are separated by passageways, but between sections 2 and 3 there is on each floor an inspection room for adjusting all breaker units before rolling into place.

FHKO-139 type with 400-amp., 138-kv. rating and are provided with by-pass switches to facilitate maintenance. Oxide-film arresters have been placed between the breakers and the transformers; in addition, flash-gaps have been installed. The transformers are of the non-resonating (shielded) type, with a nominal ratio of 13,200 to 138,000 volts, and are provided with one 2½ per cent tap above and two 2½ per cent taps below normal on the high-voltage side.



International Capital in Europe's Electric Utilities

By EMIL L. JORDAN

Formerly Economist International Public Service Corporation, New York

RADICAL technical progress in the generation and application of electric energy naturally has resulted in equally radical changes in the organic and financial structure of Europe's public utilities. The process of development in this industry has been more thorough-going than in others. Only twenty years ago the electric plant was a purely local affair. The circle of consumers was limited by the municipal district, and not much consideration was given to the question of the power source.

Today the electric utilities have grown far beyond local interests and have an international significance. The local plant in Europe, however, still plays an equal part with the country-wide central. In another twenty years the generation of electric energy, according to all indications, probably will be concentrated at Europe's coal, lignite and hydro power sources, and the different countries will be supplied with energy from international main transmission lines. This idea, which was aired in a clear and impressive form for the first time at the World Power Conference in Berlin, has aroused lively interest not only in Europe but also in America and is regarded as the program of future development.

Municipal and state participation

At the inception of the power industry private operation was the rule. Around 1900 the trend changed in the direction of public ownership. Only a few countries in Europe, for instance Italy, carried on through the medium of private business. Recently, however, the part played by private interests has increased considerably and is now predominant in the majority of countries. Municipal operation is usual only so far as vital interests of the individual community are concerned, but not in the case of power centrals with country-wide activities. Also, the capital necessary today is so large, especially for the utilization of hydro power, that not even are the national, and far less the local, money markets in the European countries able to raise the necessary funds. Thus the participation of international capital has become general.

On the other hand, the municipal and state units do not like to lose their influence over the electric supply of their community. The problem is to find a means of satisfactory co-operation. Participation of local and state governments in internationally financed public utility companies is very usual in Europe, and from the international viewpoint not undesirable.

This co-operation of international capital with the directly concerned local units seems to be the adopted program of future development for the industrially and financially strong countries of Europe.

For the international marketability of European public utility securities all necessary conditions have been created within the last few years. The leading stock exchanges and the most influential banking houses in the world participate in this development, a fact which qualifies Europe's public utilities as a first-class international investment.

Financing policies

In what form does international capital flow into Europe's public utilities? Two different directions are distinctly discernible. In industrially strong countries, especially in England, France, Italy and Germany, the initiative of financing and the operation of the generating and distributing systems lie in national hands, which apply international, mostly American, capital on a large scale, without giving up the control of the enterprise. This indirect financing consists generally of long-term bond issues, which give the creditor a certain moral influence but not a direct partnership. The American-European co-operation in this form is especially strong in Italy, whose public utilities show a similar financial structure to that of the American utilities.

In the smaller and financially weaker countries, however, international capital has taken the initiative, and in the majority of cases exercises the operating control by means of holding companies. These companies usually participate in each other by reciprocal stock ownership and represent in a lesser degree a row of units working side by side, rather than a net of numerous mingled interests in which all leading national banks of Europe participate and which excel in internal strength and external flexibility.

American participation in the direct financing of Europe's public utilities by holding companies up to now has not been so substantial as in indirect financing. But in the case of corporations launched within the last year, American interests have participated in large measure, such influential houses as Electric Bond & Share Company and J. P. Morgan & Company participating.

The accompanying table of leading public utility hold-

ing companies does not claim to be complete, but offers a comprehensive picture of the situation. The conception "holding company" is to be understood with the restriction that many of these corporations at the same time directly operate a number of centrals of their own. A few enterprises, like "Sofina" and "Gesfürel," at the same time control important industrial units of different lines, especially in the chemical and mining industries. But this amplification of interests is to be considered as the exception.

The financial organization of these holding companies is typically European; that is, very simple in structure. In many cases there is only one class of common stock with equal rights and there is no funded debt. In some cases preferred stock with a fixed interest rate exists in addition to common stock, but a far-going diversification, with scaled voting and other rights, is never provided, as is usual in America. All shares have a par value, as in most of the European countries the non-par-value share is illegal.

In the tabulation of the holding companies the column showing year of organization shows how rapidly the holding movement has increased in recent years. Five newly organized companies have not yet declared their first common stock dividend.

The international quality of the relation becomes evident from the last column. Indicating the different countries, only stock majorities or substantial stock

Leading Utility Holding Companies With Interests in Europe

Location of Company	Company	Internationally Known as	Founded in	Capital and Reserves	Latest Dividend, Per Cent	Funded Debt (Bonds)	Interest Rate, Per Cent	Interest in
Belgium	Societe Financiere de Transports et d'Entreprises Industrielles, Brussels	"Sofina"	1898	$27,880,000	5	.....	.....	Belgium, France, England, Germany, Italy, Spain, Portugal, Hungary, Turkey, Canada, Argentina, Siam.
	Soc. Int. d'Energie Hydro-Electr...	"Sidro"	1923	34,850,000	6	.....	.....	Spain and Mexico.
	Soc. d'El. de la Region de Malmedy	"Serma"	1928	18,122,000	..	.....	.....	Belgium, France and Luxembourg
	Comp. Italo-Belge pour Entreprises d'Electricite et d'Utilite Publ....	"Cibe"	1929	21,000,000	7	.....	.....	Spain, Portugal, Greece, Rumania, Hungary, Egypt.
	Comp. Europeenne pour Entreprises d'Electricite et d'Utilite Publ....	"Europel"	1929	69,700,000	..	.....	.....	Austria, Germany, Poland, Spain, France, Hungary, Italy, Belgium, Greece.
	Comp. Generale d'Entreprises Electriques et Industrielles, Brussels..	"Electrobel"	1929	122,200,000	25	.....	.....	Belgium, France, Italy, Rumania, Poland, Lithuania, Latvia, Portugal, Bulgaria, Turkey, Egypt, Argentina, China, Siam, East Africa
	Soc. Belgo-Polon. de Force et de Tr.	"Sobelpol"	1927	19,000,000	7	.....	.....	Poland.
	Comp. Hispano-Belge d'Entrepr. Elec	"Hispanobel"	1929	55,800,000	..	.....	.....	Spain.
Canada	European Electric Corporation, Montreal	"European Electric"	1930	32,000,000	..	$12,900,000	6.5	Italy, Belgium, Germany, Spain, Poland, Austria.
England	The Gr. London & Counties Trust Lt.	.....	1925	38,000,000	..	12,000,000	6	England.
Germany	Gesellschaft f.elektr. Unternehmungen-Ludw. Loewe A. G., Berlin...	"Gesfürel"	1894	31,000,000	10	6,000,000	6 and 7	Germany, Hungary, Belgium, Spain, Portugal, Turkey.
	Preussische Elektrizitaets A. G.....	"Preussag"	1920	40,000,000	6	10,300,000	6	Germany.
	Westphalia Elec. Pwr. Corp.....	Rhine-Westphalia...	1898	64,000,000	10	44,300,000	6	Germany.
Hungary	A.G.f. Elektr. & Verkehrs Untern...	.....	1895	10,000,000	8	.....	.....	Hungary, Rumania, Yugoslavia, Czechoslovakia.
Italy	Soc. Gen. Edison di Elett., Milan...	"Edison"	1884	86,500,000	10	22,712,000	6 and 7	Italy.
	Soc. Meridionale di Elett., Naples..	"Meridionale"	1899	43,000,000	9	11,600,000	7	Italy.
	Soc. Adriatica di Elettr., Venice....	"Adriatica"	1905	19,000,000	16	8,000,000	7	Italy.
	Soc. Gen. El. dell'Adamello, Milan..	"Adamello"	1907	31,500,000	7.3	8,000,000	6 and 7	Italy.
	Unione Esercisi Elettrici, Milan....	"Unione"	1905	27,800,000	18	9,660,000	6 and 7	Italy.
Austria	Niederosterr. Escompte Ges., Dept. for Electric Energy, Vienna.....	"Escompte"	1899	13,800,000	10	.....	.....	Austria, Czechoslovakia, Hungary, Poland, Yugoslavia.
Spain	Cia. Hispano-Americana d. El., Madrid	"Chade"	1920	86,000,000	17	36,100,000	6	Argentina, Belgium, France, Germany.
U. S. A.	Italian Superpower Corporation....	.....	1928	.....	6	22,250,000	6	Italy.
	Intern. Power Securities Corp.....	.....	1923	.....	$1*	33,415,000	6 and 7	Italy and France.
Switzerland	Swiss-American Electric Co., Zurich	"Swiss-American"...	1928	22,700,000	..	4,852,000	5.5	Switzerland, Argentina, Italy, Paraguay, Colombia, Peru.
	Motor-Columbus A.G. for Electr. Enterprises, Baden	"Motor-Columbus".	1917	16,500,000	10	12,900,000	5	Switzerland, Italy, France, Spain, Argentina, Colombia, Peru, Paraguay.
	Bank for Electrical Enterprises, Zurich	"Electro-Bank".....	1895	23,300,000	12	.....	.....	Switzerland, Italy, France, Spain, Germany, Austria, Portugal, Poland, England.

*$1 per year.

minorities are considered, but not small stock minorities; the latter have no voice in the administration. Also to some non-European, especially South American, countries these European interests have been expanded.

For the new large-scale tasks of Europe's public utilities a financial structure has been created which corresponds with the demands of the present time and with the expectations of the future. The harmonious cooperation and the merger of national and international interests represent an asset the effect of which is reaching far beyond pure public utility affairs.

▼

High-Intensity Lighting Systems for the Work-World

By M. LUCKIESH

Director Lighting Research Laboratory, General Electric Company, Cleveland, Ohio

One experienced in appraising artificial lighting from the viewpoint of seeing finds few interiors adequately illuminated. A half-seeing world seems to be still indifferent to the prevalent intensities of illumination, which at best are less than 1 per cent of those under which eyesight evolved outdoors. In many cases eyes are required to operate for long periods at fairly difficult tasks with intensities less than one-thousandth of the average daylight intensity outdoors. Still, we encounter many cases of resistance to increasing the level of illumination even when this increase does not touch the purse of the resisting individual.

Certainly no intensity of illumination obtainable indoors can possibly be offensive to the eyes or to the sensibilities. Foot-candles are complained of when they cannot possibly offend. The real culprit—if there is one—is the lighting system. By this we mean not only the diffusion and distribution of light, but the brightness of ceiling, walls, etc. All this is the lighting system in its broadest sense.

For years it has been apparent to the writer that general lighting by means of a large "indirect" component reflected from the ceiling represents the primitive stage in artificial lighting. Lighting practice is still in that stage, but in a few cases has passed beyond into a more refined stage. The use of the ceiling as a reflector of much or most of the light to the work-plane is logical and satisfactory for the first few foot-candles of the eventual hundreds that are needed for comfortable, accurate seeing and for the conservation of eyesight and human energy, but there is a limit to this kind of lighting, perhaps from 30 to 50 foot-candles, where interiors seem to be overlighted and complaints begin to be unfairly directed at the foot-candles. It is the lighting and not the illumination which is at fault.

The next step beyond the primitive stage of general lighting can be taken by the addition of localized lighting.* However, this will be taken only by the lighting specialist who knows what light can do for seeing and is willing to work harder than necessary to specify a symmetrical distribution of standard fixtures. In industrial plants this means the addition of lighting units which direct light upon each specific visual task. In general offices this may mean the addition of portable lamps, preferably fixed in relation to desks. Where practicable, a combination fixture supplying indirect lighting and properly controlled direct light may be used.

Economics now demand that really high-intensity lighting be obtained by the method which we have termed "general lighting plus." Psycho-physiological factors demand the same kind of new system, because general lighting from bright ceilings is not satisfying when the level of illumination is actually high. The writer is enjoying 80 foot-candles upon his desk, and is certain that by a proper balance of direct and indirect components there is no practical limit to satisfactory foot-candle values. It's not the light, it's the lighting that needs attention if we are to emerge from the present primitive stage.

*"*General Lighting Plus,*" M. Luckiesh, Transactions I.E.S., Vol. 24, 1929, page 233.*

▼

READERS' FORUM

Taxing Municipal Plants

To the Editor of the ELECTRICAL WORLD:

This comment is in support of Governor Meier's proposal in Oregon that municipal utilities shall carry taxation corresponding to that of private utilities. Your energetic editorial in the February 14 issue on that subject provokes the thought that city power organizations surely could equal private corporations as vehicles for collecting some share of the total tax burden. It may not be correct to say that industry and the general public have now to pay the taxes through some other channel, since untaxed municipal power systems generally have charges lower than private companies by an amount representing the tax loading at least. But, since the high-pressure propaganda of the companies seeking to abolish municipal ownership has made such a fetish of the tax bugaboo, why not shift that small amount as Governor Meier suggests?

An associated condition has to do with the non-revenue—I purposely do not term it "free"—service supplied by so many publicly owned systems to schools, charitable institutions, parks, sewerage and water plants, as well as to municipal buildings and for street lighting. Were the municipal plants to receive tax money to pay for those services, it is believed that because of the exchange it would become easier for the plants to meet a tax on their assessed valuation. From our experience with the application of one of the uniform accounting systems it is known that our gross and net income would benefit from the transfers in question. I am greatly in favor of correct accounting for both private and publicly owned systems—shall we say, in order to define the word "correct," on the basis in effect for Massachusetts properties?

A. D. WEBSTER,
Superintendent Municipal Water, Light and Ice Plants.
Orrville, Ohio.

Men of the Industry

R. H. Bennett, Jr., Assumes New Duties

R. H. BENNETT, JR., for the past six years connected with the electrical operating department of the Tennessee Electric Power Company, has been appointed superintendent of the production department in charge of operating and maintenance of all company hydro and steam generating developments to succeed H. H. Bailey, who has assumed new duties as assistant manager of the

Chattanooga district. Mr. Bennett became identified with the Tennessee utility in 1924. Prior to that time he was with the General Electric Company, Schenectady. He is a graduate of Trinity College, now Duke University; Emory College, Atlanta, Ga., and Union College, Schenectady, N. Y.

▼

B. B. MORTON of Basin, Wyo., has been appointed a member of the Public Service Commission of Wyoming.

•

ARTHUR E. ROWE, president A. E. Rowe Company, Inc., has been elected president of the San Francisco Electrical Development League, succeeding Ernest Ingold.

•

LESLIE R. HICKS, formerly electrical engineer of M. J. Daley & Company, Inc., Springfield, Mass., and at one period head of the electrical engineering department of Charles H. Tenney & Company, Boston, has joined the engineering staff of the Western Massachusetts Companies, with headquarters at Springfield. T. B. FLEMING, transmission specialist of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has also joined the engineering department of the Western Massachusetts group.

•

JAMES C. BRADY, JR., has been added to the board of directors of the Brooklyn Edison Company, Inc.

•

M. REESE HATTABAUGH of Grangeville has been appointed a member of the Public Utilities Commission of Idaho by Gov. C. Ben Ross to succeed Frank E. Smith, whose term has expired.

•

V. H. MOON, since 1922 appliance sales superintendent of the Pacific Power & Light Company, Portland, Ore., has been appointed sales manager of that company and given the broader responsibility of directing the general commercial development program of the company in addition to the development of the domestic field, which he has had charge of in recent years.

•

C. M. THOMAS, attorney of Medford, Ore., and formerly Circuit Judge of the first judicial district of Oregon, has been appointed by the Governor to the new post of Commissioner of Public Utilities of Oregon in accordance with the law just passed by the Oregon Legislature and signed by the Governor. Judge Thomas has been a resident of Medford since 1913 and has been prominent in the politics of that region of the state, having served both in the Senate and in the House of Representatives.

•

DOUGLAS DOW, formerly farm service adviser and special engineer with the Detroit Edison Company, has recently been appointed Commissioner of Purchases and Supplies for the city of Detroit. Prior to his work in the sales department of the Detroit utility, Mr. Dow was assistant buyer and later chief clerk of the record and research division of the purchasing department. His training includes an engineering degree from the University of Michigan and four years' work, including the test course, at the General Electric Company's Schenectady plant. Mr. Dow has been active in the electrical industry, especially in farm work electrification, and at the time of his appointment to the city position was the Great Lakes division representative in the Commercial National Section, N.E.L.A. He is a son of Alex Dow, president of the Detroit Edison Company.

J. McKinley Assumes New Executive Duties

JOSEPH MCKINLEY has been appointed acting vice-president in charge of sales and service of the Duquesne Light Company and the Equitable Gas Company. He succeeds George E. Whitwell, who, as announced in the March 7 issue of the ELECTRICAL WORLD, has become vice-president in charge of sales for the Philadelphia Electric Company.

Mr. McKinley was born on May 31,

1877, in Pittsburgh, Pa., and was graduated from Pennsylvania State College in 1900 in electrical engineering. Following his graduation he entered the employ of the Westinghouse Electric & Manufacturing Company. In 1903 he entered the employ of the Allegheny County Light Company, now the Duquesne Light Company. He was the first power salesman for the company and later served as manager of power sales, general contracting agent, manager of the wholesale sales and service department of the Duquesne Light Company and Equitable Gas Company.

Mr. McKinley is a member of the Engineers Society of Western Pennsylvania, Association of Iron and Steel Electrical Engineers, National Electric Light Association, American Gas Association, the Electric League of Pittsburgh and the Pittsburgh Chamber of Commerce.

▼

BENJAMIN M. TASSIE was elected president of Manning, Bowman & Company, Meriden, Conn., at the recent meeting of the board of directors, to

succeed the late R. P. Tracy. Mr. Tassie has been identified with the Manning, Bowman organization since 1914 and in that period of time has been an important factor in the development of the company's business.

C. R. Boggs, vice-president and factory manager of the Simplex Wire & Cable Company, Boston, Mass., has been elected a Fellow of the American Association for the Advancement of Science.

▼

OBITUARY

Gerald W. Hart

Gerald W. Hart, founder and president of the Hart Manufacturing Company, died at his home in Hartford, Conn., March 8, following a heart attack. Mr. Hart was 74 years of age. He entered upon his business career in 1880 with the North & Judd Manufacturing Company, having studied at Yale University for four years. After a short connection with that organization he became identified with the American Electric Company of New Britain, formed to build the arc-lighting apparatus of Messrs. Thomson and Houston of Philadelphia. In 1882 he was sent to Kansas City, Mo., to install equipment for the Kansas City Electric Light Company. He remained in that part of the country for several years, installing plants in various cities, and later was appointed assistant general manager of the Kansas City Electric Light Company and superintendent of the Edison Electric Light & Power Company of Kansas City, with which the Kansas City Electric Light Company was affiliated. In 1889 George S. Hegeman, a classmate of Mr. Hart's, joined the Edison company, and it was not long before they were collaborating on the manufacture of electric switches. Their undertaking met with such success that within a year they organized the Hart & Hegeman Company of Kansas City, later transferring the business to Hartford. Following the death of Mr. Hegeman, in 1897, Mr. Hart organized the Hart Manufacturing Company of Hartford, which at the present time manufactures many devices in the electrical line as well as switches. Mr. Hart was a member of the Hartford Manufacturers' Association, the Manufacturers' Association of Connecticut, the Society of Automotive Engineers and the Machinery Club of New York City.

▼

Samuel A. York, president of the Merchants National Bank, New Haven, Conn., and a director of numerous public utility companies in New England, died March 7 at his home in New Haven after an illness of several weeks. Mr. York was born in New Haven in 1868 and was graduated from the Yale Law School in 1892. He began the practice of his profession in his native city and later, becoming interested in finance, he soon directed his attention to electric power companies, particularly those in eastern Massachusetts associated with the Charles H. Tenney management. He was elected president of the Merchants National Bank of New Haven several years ago and served in that capacity to the time of his death. Mr. York served on the directorate of the North Boston Lighting Properties, Salem Electric Light Company, Suburban Gas & Electric Company, Eastern Massachusetts Electric Company, Haverhill Electric Company, Fitchburg Gas & Electric Company, Walden Electric Company, Beverly Gas & Electric, all in Massachusetts; the Concord Electric Company in New Hampshire, the Rockland Light & Power Company in New York, the Rockland Electric Company in New Jersey and the Pike County Electric Company in Pennsylvania, in addition to numerous gas companies. Among the industrial enterprises with which he was connected were the Acme Wire Company of New Haven as director and the American Tar Company of Boston in the same capacity.

•

James Douglas Hamilton Dickson, who has just died at Cambridge, was the assistant of Lord Kelvin in his electrical researches. Mr. Dickson, who was the senior fellow of Peterhouse, was 81 years old. He was concerned in the first Atlantic cable and assisted Sir James Dewar, as well as Kelvin, in his researches. Born on May 1, 1849, in Glasgow, the son of a prominent physician of that city, he studied at Glasgow University, where he had an exceptionally brilliant career. There he attracted the notice of Prof. Sir William Thomson (later Lord Kelvin), who employed him in 1867 on important mathematical calculations, particularly for electrical researches. Together with W. F. King of Edinburgh and Charles Cuttriss of Boston, Mass., he constructed the apparatus and made the preliminary experiments for Kelvin's determination of "V," the ratio of the electromagnetic to the electrostatic unit of electricity. When in 1869 Kelvin, who had been technical adviser to the promoters of the first Atlantic cable of 1858, accepted the appointment of electrical engineer for the new French cable, Mr. Dickson accompanied him to France, and on the completion of the cable remained in the service of the French concern as electrician in charge at Brest. On the advice of Kelvin he resigned his post to go up to Cambridge University. Admitted to Peterhouse in 1870, as foundation scholar, four years later he was elected to a fellowship, which he held for the rest of his life. Mr. Dickson published occasional papers on scientific subjects, principally on thermodynamics and thermoelectricity.

•

Harry J. Hunsicker, mechanical engineer with the New York Power & Light Corporation, died March 6, of acute dilation of the heart. Mr. Hunsicker had been associated with the electrical industry up state since 1903. He was active in building the Spier Falls hydraulic project. Mr. Hunsicker was born in Lehighton, Pa., and was graduated from Pennsylvania State College with a degree in electrical engineering. He was a member of the American Institute of Electrical Engineers. Mr. Hunsicker was 56 years of age.

•

Frank K. Hoover, contracting engineer and long-time resident of Chicago, died at his home in that city March 6, in his seventy-eighth year. Mr. Hoover was a director in the Hoover Company, North Canton, Ohio, and the Hoover & Mason Phosphate Company of Chicago and Mount Pleasant, Tenn., and was the head of the Hoover & Mason Company, contracting engineers, from the time of the firm's establishment in 1894 until its discontinuance in 1925. A native of North Canton, he moved to Kansas City, Mo., in 1879 and engaged in the wholesale agricultural implement business, later in the electric lighting and street lighting business and became president of the Kansas City Edison Company. In 1894 he left the central-station field to enter the manufacturing branch of the industry.

•

George T. Barrows, well known in electrical contractor-dealer circles, died January 27, following an illness of a month's duration. For the past 25 years Mr. Barrows had devoted his time especially to promoting the progress of the contractor-dealer branch of the electrical industry. A native of Lock Haven, Pa., he removed to Washington, D. C., and then to Pittsburgh. After a connection with the Carnegie Steel Company, he entered the employ of the Duquesne Light Company and then established an electrical contracting business. In 1925 he became president of the Electric League of Pittsburgh and in 1927 manager; one year later he resigned from league work to direct the promotion of adequate domestic wiring in the Pittsburgh territory for the Duquesne Light Company. Mr. Barrows was 57 years of age.

Financial and Statistical News

DEFINITE plans for early commencement of interconnection between leading Eastern utility systems is interpreted as indicative of a trend likely to be marked in the industry this year. Further co-ordination between different groups is said to be under discussion and a definite simplification of relationships in some of the leading groups is aimed at. This will involve large-scale transfers of control stocks.

——YIELD ON COMMON STOCKS is again down to around 3 per cent as market buoyancy continues. The average price of 37 operating and holding company stocks is now 74, against 72.4 last week and 65.7 at the beginning of the year.

▼ ▼ ▼

January Revenue Higher

January revenue of electric light and power companies was, on the average, somewhat higher this year than in 1930. Reports from representative companies throughout the country show an increase of 1.3 per cent; at this rate the total for the industry was about $200,900,000, against $198,300,000 a year ago. This constitutes an upward turn from two preceding months. Kilowatt-hour sales, however, continue low, missing the 1930 figure by 5 per cent. Evidently expanding residential use is neutralizing the loss of revenue due to subnormal demands for industrial power. Regionally, revenue gains of 2 per cent or better are reported from the Middle Atlantic industrial area and the Far West, but current operations in the central industrial regions continue 5 per cent below last year's level.

Although these are preliminary figures it is not probable that any important changes will result from the inclusion of returns from additional reporting companies.

▼

Utilities Power & Light Adds to British Holdings

ANNOUNCEMENT HAS BEEN MADE of the acquisition of the South Wales Electrical Power Distribution Company by the Utilities Power & Light Corporation through indirect ownership. The South Wales property was acquired by the Shropshire, Worcestershire & Staffordshire Electric Power Company, an operating unit of the Greater London & Counties Trust, Ltd., which is controlled by Utilities Power & Light.

The South Wales company adjoins the Shropshire company on the south and serves an area having a population of more than a million people. The company is empowered to supply electric energy in bulk throughout Glamorgan and the whole of the industrial part of Monmouthshire. It distributes retail power in about one-third of this area. Among the customers of the company are municipalities and many of the leading steel mills, tin plate works and other manufacturing companies.

The purchase gives the Shropshire company the largest area of electrical energy production and distribution under a single management in Great Britain. This area embraces more than 11,000 square miles, reaching from the north of Birmingham to the English Channel and from the Bristol Channel to the North Sea.

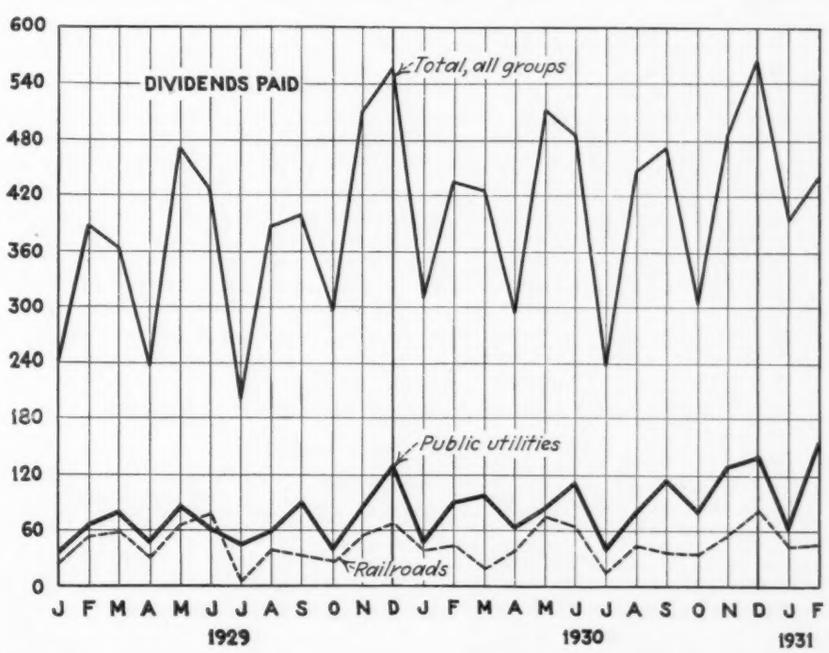
▼

Southern California Edison to Increase Stock

STOCKHOLDERS OF THE Southern California Edison Company, Ltd., will vote March 20 on increasing the authorized common stock from $100,000,000 to $110,000,000 and on approving a reduction in the 5½ per cent series C preferred stock from $66,000,000 to $56,000,000.

▼ ▼ ▼

Dividends Paid by Utilities at New High Level



DIVIDENDS PAID BY UTILITIES reached a new high point in February, against a smaller than usual increase for a representative group of all classes of securities and a negligible increase in the case of railroad issues.

As will be seen from the chart, February usually marks a substantial peak in dividend payments by all groups. This illustrates the favorable position of the utility group at this time despite depressed business.

Northern Illinois Company Sold 13 per Cent More Power

THE utilities made a better showing in 1930 than any other major group, but actual individual gains, where they appeared, were very small. Public Service Company of Northern Illinois is among the exceptions, having shown a gain of 6.2 per cent in gross revenue and of 5.3 per cent in net, against a gain of less than 3 per cent for the industry as a whole in both gross and net revenue.

Kilowatt-hour sales by the company increased sharply. The 1930 total was 1,195,446,343, against 1,056,558,905 for 1929, a gain of 13.1 per cent. Residential and commercial sales of energy advanced 7.8 per cent.

Three rate reductions made

During the year the company voluntarily inaugurated three new electric rates which are effecting substantial savings to customers. These reductions will result in a saving to the company's customers of about $1,750,000 over a twelve-month period, it is stated. The actual saving during 1930 was about $928,000. These rate cuts were made possible partly by the increase in energy used by existing customers as well as by the growth in number of customers, hence the rise in revenue despite rate reduction. Electric customers alone increased by more than 7,000.

In the aggregate, approximately 825 circuit-miles of electric lines of all voltages were built during the year 1930. Of this total mileage, approximately 466 was built for service in rural territory. It is interesting to note in this connection that during the year 2,017 farm customers were added to the company's lines, making the total number of farm customers now being served 6,822, or 28.7 per cent of all farms in the company's territory. The estimated yearly revenue to be derived from the new farm customers obtained is $138,000.

Merchandise sales, including retail and wholesale; incandescent lamps, and miscellaneous jobbing, revenue from which is not included in operating revenue, amounted to $2,465,525. Approximately 48,000 electric and gas appliances were sold during the year.

▼

Revenue Rose 19 per Cent in Three Years

CENTRAL-STATION REVENUE in the United States totaled $2,151,150,000 in 1930, according to reports received by ELECTRICAL WORLD from operating companies throughout the country. This figure is comparable with the $1,802,655,493 of the latest census report on the industry, that for 1927; both involve the moderate duplication due to intercompany sales. The increase compared with 1929 is $45,250,000, or 2.1 per cent. Operating and maintenance expenses were $946,180,000, against $934,890,000 in 1929; net earnings, therefore, increased nearly 3 per cent.

Taxes, amounting approximately to $200,000,000, and allowance for depreciation, obsolescence and amortization are not included in the figures for operating and maintenance expenses.

Energy generated, 89,651,986,000 kw.-hr., was about 2 per cent less than in 1929; of this total, 30,330,187,000 kw.-hr. came from water power and 59,321,799,000 kw.-hr. from fuels. The former was 6.4 per cent less than in 1929, while the latter was slightly greater, both changes reflecting the effects of the unusually low stream-flow for which 1930 was conspicuous.

In general, the various annual totals are in close agreement with those published at the beginning of the year, which were necessarily based on incomplete data, except that the output from water power was lower and that from fuels higher, due to unanticipated severity of the drought in the final months.

Revenue and Energy Output of Central Stations in the United States in 1930

Month 1930	Total Gross Revenue from Sale of Energy, Thousands	Total Operating and Maintenance Expense,* Thousands	Energy Generated—Thousands of Kw.-Hr. Total	Hydro	Fuel
January	$198,300	$81,480	8,154,531	2,790,505	5,364,026
February	185,800	77,300	7,177,064	2,581,538	4,595,526
March	176,200	77,200	7,673,866	3,082,097	4,591,769
April	176,300	78,300	7,510,801	3,082,049	4,428,752
May	172,900	77,900	7,496,622	2,955,150	4,541,472
June	169,200	76,400	7,211,608	2,764,768	4,446,840
July	167,200	77,500	7,328,621	2,589,885	4,738,736
August	168,100	78,300	7,352,191	2,234,477	5,117,714
September	174,940	78,800	7,285,807	2,036,309	5,249,498
October	182,950	81,640	7,686,787	2,068,105	5,618,682
November	187,340	78,840	7,206,214	1,991,684	5,214,530
December	191,920	82,520	7,567,874	2,153,620	5,414,254
1930 totals	2,151,150	946,180	89,651,986	30,330,187	59,321,799
1929 totals	2,105,900	934,890	91,421,455	32,390,395	59,031,060

*Do not include interest, taxes, depreciation or sinking fund, with some unavoidable exceptions.

▼

NEWS BRIEFS

Capital stock of the Brooklyn Edison Company, Inc., has been stricken from the list of the New York Stock Exchange.

•

First and refunding mortgage 4 per cent bonds of the Philadelphia Electric Company, series of 1971, have been added to the list of bonds legal for investment by savings banks in the State of New York.

•

Stockholders of the Kansas City Power & Light Company will vote March 30 on authorizing an increase in the bonded indebtedness of the company.

•

Louisville Gas & Electric Company will redeem on May 1 at 105 and interest all its first and refunding mortgage 30-year 5½ per cent gold bonds, series B, dated May 1, 1924, and maturing May 1, 1954.

•

Record dates of stockholders of the National Electric Power Company eligible for dividend payments have been advanced from the 15th to the 10th of the month for the preferred stocks and from the 20th to the 10th for the class B common stock.

•

Stockholders of the Scioto Valley Railway & Power Company, Columbus, Ohio, are offered a new proposition in which they can exchange their stock, both common and preferred, for participating preferred shares of the American Electric Securities Corporation, a New York financing organization, it is announced by Stevenson, Vercoe, Fuller & Lorenz, stock and bond dealers of Columbus. The offer of the American Electric Securities Corporation succeeds a proposition made to the Scioto Valley company last fall by Glen R. Snider and his associates, which, owing to the depressed financial situation and to litigation seeking to reverse the action of the Public Utilities Commission of Ohio authorizing the abandonment of the Scioto company's unprofitable transportation system, were unable to carry out their contract. The offer of Mr. Snider and his associates included $5 per share for the common stock and $15 per share for the second preferred, which compares with approximately $6 per share for the common and $18 per share for the preferred offered by the American Electric Securities Corporation.

Industry Picks Up

DEFINITELY increased industrial activity is indicated by the rise in the ELECTRICAL WORLD index for February. This index is compiled from reports of electrical energy consumption by individual plants, received each month in a continuous survey covering manufacturing establishments throughout the United States.

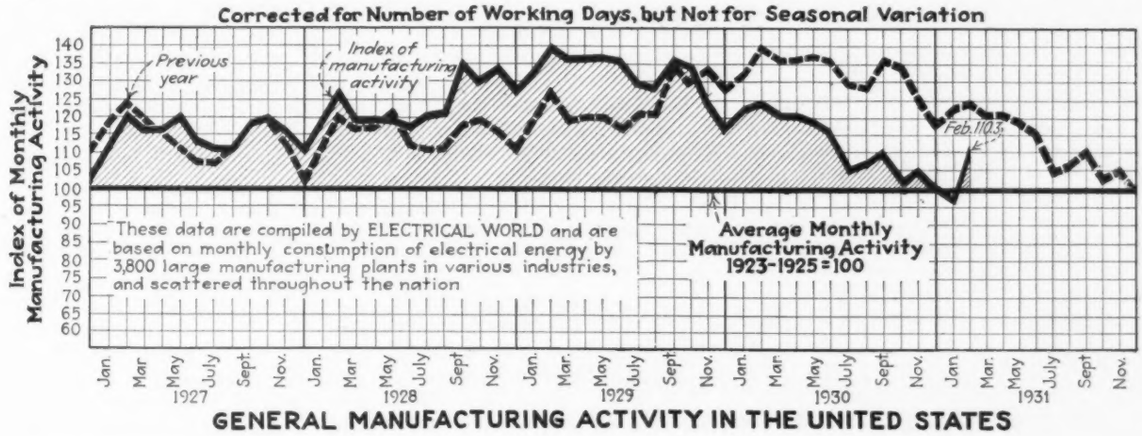
Adjusted for the shorter working month, February returns show a weighted average for all manufacturing 13 per cent above that for January, well above the averages for other recent months and a scant 11 per cent lower than a year ago, when the industrial depression was still young.

Without exception, every industry group advanced, compared both with January and with December; current operations are approaching last year's level. Activity in metal-working establishments advanced 18 per cent from December, in iron and steel mills 20 per cent. The manufacture of automobiles, parts and accessories rose 14 per cent over December and 19 over November. The metals group, embracing both mills and metal-working plants, rose from the valley following two and a half high years.

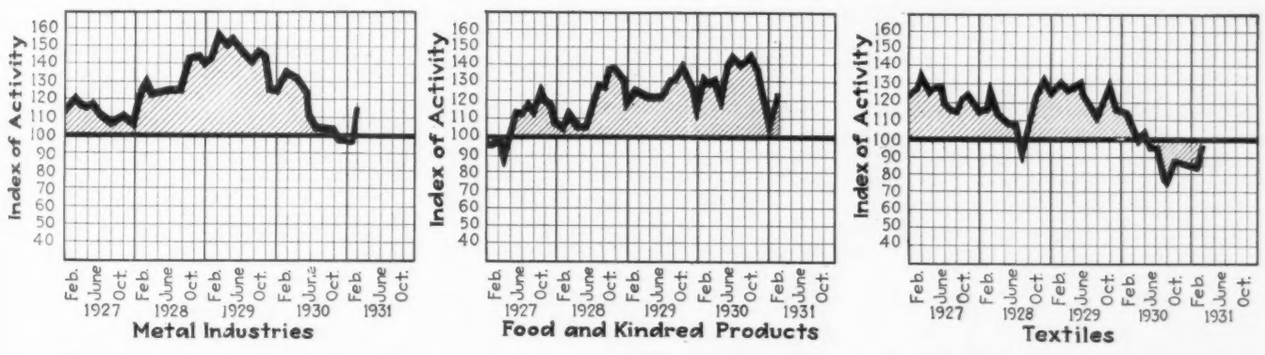
Textiles rose 13 per cent from the average of the three preceding months after an earlier gain from the low point in August; rubber has advanced 31 per cent since November; leather has climbed steadily for a number of months.

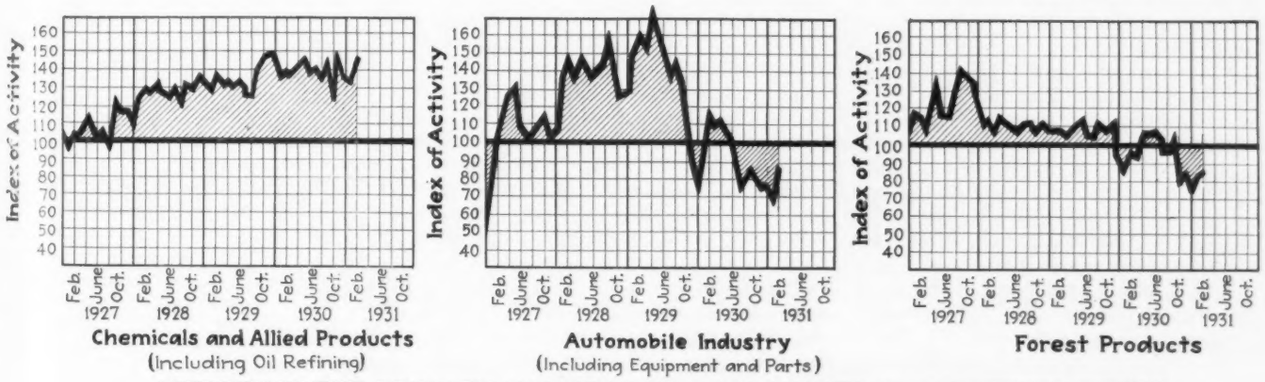
Index of Manufacturing Activity

Industrial Group	Feb., 1931	Jan., 1931	Dec., 1930	Nov., 1930	Feb., 1930
	Base Average Month 1923-25				
All industry	**110.3**	**97.6**	**99.1**	**104.3**	**123.5**
Automobiles (incl. parts and accessories)	88.9	67.5	77.9	74.9	116.6
Chemical products (incl. oil refining)	146.6	132.0	133.5	145.0	139.6
Food products	122.0	118.3	107.1	124.4	129.2
Iron and steel	116.5	103.4	110.2	106.5	143.0
Metal working	112.3	95.0	97.8	89.6	130.5
Leather products	76.1	71.6	68.7	63.0	86.5
Forest products	84.2	82.6	73.3	86.5	94.7
Paper and pulp	127.0	111.8	117.0	112.3	138.0
Rubber products	112.9	99.0	84.3	86.1	133.1
Shipbuilding	114.8	113.9	99.0	105.5	125.4
Stone, clay and glass	102.6	75.3	100.6	106.2	116.7
Textiles	99.3	86.1	89.8	87.0	103.3


Corrected for Number of Working Days, but Not for Seasonal Variation
Index of Monthly Manufacturing Activity
Previous year
Index of manufacturing activity
Feb. 1931
These data are compiled by ELECTRICAL WORLD and are based on monthly consumption of electrical energy by 3,800 large manufacturing plants in various industries, and scattered throughout the nation
Average Monthly Manufacturing Activity 1923-1925=100
Jan. Mar May July Sept Nov. Jan. Mar May July Sept Nov. Jan. Mar. May July Sept Nov. Jan Mar May July Sept Nov. Jan. Mar. May July Sept Nov.
1927 1928 1929 1930 1931

GENERAL MANUFACTURING ACTIVITY IN THE UNITED STATES


Index of Activity
Feb. June Oct. Feb. June Oct. Feb. June Oct. Feb. June Oct. Feb. June Oct.
1927 1928 1929 1930 1931
Metal Industries
Food and Kindred Products
Textiles


Index of Activity
Feb. June Oct. Feb. June Oct. Feb. June Oct. Feb. June Oct. Feb. June Oct.
1927 1928 1929 1930 1931
Chemicals and Allied Products
(Including Oil Refining)
Automobile Industry
(Including Equipment and Parts)
Forest Products

ACTIVITY IN THE PRIMARY MANUFACTURING INDUSTRIES OF THE UNITED STATES

Business News and Markets

Saturation Not in Sight in Appliance Field

SATURATION in the sale of appliances is not on the horizon, according to a survey of the household appliance field recently completed by David M. Debard, Stone & Webster engineer. Of the 20,000,000 homes now wired for electrical energy use in this country, Mr. Debard finds, only 30 per cent of the electrical appliance market has been sold. The estimate shows that possibilities for expansion of residential, commercial and industrial uses of electrical energy are 62 per cent short of full development. It is also argued that, in spite of the fact that industrial and commercial uses of electrical energy are constantly increasing, especially since the railroads have begun electrification on a tremendous scale, it is possible to develop the market for electrical energy use in the home so as to expect 50 per cent of the power companies' revenue from that source. The report states:

"The average kilowatt-hour use of service in the home in the country as a whole is now less than 550 per annum, and many localities are far from this figure. Cities such as Detroit will soon exceed the 600 mark. Seattle reports in excess of 1,000, largely resulting from an intensified sale of ranges. One or two companies are reporting in excess of 1,600 kw.-hr. per annum for average home use, but in this case there is a considerable range and water heating load. A recent survey shows only three of the twelve major time- and labor-saving devices in general use and only one of the seven principal health and comfort devices in more than one-third of the 3,000 homes covered."

An estimate has been made that all but 5 per cent of the wired homes are equipped with electric irons and some other small appliances. In spite of the accepted popularity of radio, only 55 per cent of the wired homes are so equipped, leaving 45 per cent as a potential market. Mr. Debard finds that, among the other labor-saving devices, 32 per cent of the market for cleaners has not been touched, while 61 per cent of the homes are without toasters, 70 per cent without percolators, 87 per cent without refrigerators, 94 per cent without ranges, 96 per cent without oil burners and 97 per cent without water heaters.

It is estimated, without taking into account new developments in the electrical field, that, based on reasonable and satisfactory rates, there is a possibility of an average annual gross income per wired home of $174. This would be divided as follows:

Lighting	$24
Miscellaneous service	15
Refrigerator	30
Range	45
Water heating	60

▼

Canada May Exclude Russian Coal

CANADA INTENDS TO RAISE the tariff duty on electrical apparatus, according to present indications. This is in accord with Premier Bennett's policy to develop home industries. There is a strong likelihood also that an embargo will be placed on Russian coal, lumber and pulpwood. Conflicting reports appear as to the effectiveness of the Canadian tariff policy to date. Dominion Bureau of Statistics figures do not reflect any radical increase in home production yet.

▼

General Electric Pension Plan Helps Employees

Every employee of the General Electric Company in Schenectady who has been out of work this winter, or even on part-time employment, has been cared for financially by the company's unemployment pension plan, thus materially lessening the burden of community relief work, it has been announced by Carl W. Snyder, chairman of the Mayor's Committee on Unemployment in Schenectady.

In announcing that the unemployment plan mutually adopted by the employees of the General Electric Company and the company last summer has cared for all its own employees here, the board of administrators of the plan stated that 682 employees who have been entirely laid off have received a total of $69,987 in payments or loans thus far, and that 1,509 emloyees on part-time employment have received $38,610 under the plan, making a grand total of 2,191 employees assisted and $108,598 paid out up to the end of February. The plan provides for payments into the fund of 1 per cent of wages by employees, which is matched by an equal contribution by the company during normal periods of employment, and during any emergency, such as has now been declared, all employees whose earnings are 50 per cent or more of normal, including all salaried workers from president to office boy, contribute 1 per cent to the fund, which is also matched dollar for dollar by the company.

▼

N.E.M.A. Notes

The wiring materials division of the National Electrical Manufacturers' Association at a recent meeting appointed F. C. Hodkinson, American Circular Loom Company, as chairman.

The refrigeration division recently made the following appointments of committee chairmen: Advisory committee, Louis Ruthenburg, Copeland Products, Inc.; commercial practices committee, F. E. Smith, Servel, Inc.; codes and ordinances committee, M. C. Terry, Westinghouse Electric & Manufacturing Company; technical committee, H. M. Williams, Frigidaire Corporation; non-metallic sheathed cable section, J. H. Crawford, General Electric Company; technical committee, H. H. Weber, General Cable Corporation, and resistance type furnace section, G. W. Tail, Jr., Leeds & Northrup.

At a meeting held Jan. 22 the Standards committee approved standard horsepower and speed ratings for class AH1 squirrel-cage alternating-current elevator motors ranging from 1 hp. 1,800 r.p.m. to 40 hp. 600 r.p.m. These ratings are as follows:

Horsepower	Speed, R.p.m.				
1	1,800	1,200			
2	1,800	1,200			
3	1,800	1,200			
5	1,800	1,200	900		
7½	1,800	1,200	900	720	
10	1,800	1,200	900	720	600
15		1,200	900	720	600
20		1,200	900	720	600
25		1,200	900	720	600
30			900	720	600
40			900	720	600

At the same meeting several rules on operation of polyphase motors on 50 cycles were approved. The standard 50-cycle voltages which were adopted are 110, 220, 440, 550 and 2,200. The following rule on heating was approved:

The 60-cycle polyphase motor when operated on 50 cycles, at the maintained voltages, i.e., 110, 220, 440, 550 and 2,200, will operate without injurious heating and in no case is the temperature rise to exceed 50 deg. C.

A standard was also adopted stating

that there shall be no change in the horsepower rating of the 60-cycle polyphase motor when operated on 50-cycle circuits at the maintained voltage in either the squirrel-cage or wound-rotor types and in accordance with the above rule.

▼

Westinghouse Sales Billed Down 16.6 per Cent

THE ANNUAL REPORT of the Westinghouse Electric & Manufacturing Company for 1930 shows a reduction of 16.6 per cent in sales billed, from $216,364,588 to $180,283,579. Net manufacturing profit declined from $21,992,601 in 1929 to $8,312,461 last year, although cost of sales was reduced substantially.

Reduction in sales and income in 1930 reflects removal of manufacture of radio sets and tubes, as well as decrease in general business. The net earnings per share were $4.45. As of December 31, 1930, unfilled orders amounted to $40,208,181, which compares with $62,025,399 for the preceding year.

▼

New York Metal Prices

	March 4, 1931 Cents per Pound	March 11, 1931 Cents per Pound
Copper, electrolytic	10⅛	10
Lead, Am. S. & R. price	4.60	4⅛
Antimony	7	7¼
Nickel, ingot	35	35
Zinc, spots	4.40	4.35
Tin, Straits	26.75	27.15
Aluminum, 99 per cent.	23.30	23.30

▼

To Develop Equipment for Resistance Heating

A NEW COMPANY has been organized to develop and exploit electric resistance heating equipment to be known as the Ajax Electric Company, Inc. The Electric Resistance Furnace Company, subsidiary of the Electric Furnace Company, Ltd., of Great Britain, has developed an extensive line of electric resistance heating equipment which the new company intends to exploit here.

Electric Furnace Company, Ltd., with headquarters in London, has been associated with the Ajax Metal Company and with the Ajax Electrothermic Corporation for a great many years, that company having exploited the sale of Ajax-Wyatt and Ajax-Northrup equipment throughout the British Empire and in France and Belgium.

Electric Resistance Furnace Company will be associated with the Ajax Electric Company, Inc., in this new project.

Ajax Electrothermic Corporation, the division of the Ajax Metal Company which manufactures and exploits the Ajax-Northrup high-frequency coreless induction method of heating, has from the beginning operated as a separate company, but is largely controlled by the Ajax Metal Company. The Ajax-Wyatt division, which has manufactured and exploited the Ajax-Wyatt submerged resistor induction type furnace, has up to this time operated merely as a department of the metal company. It is now intended to divorce the Ajax-Wyatt electric furnace division and accordingly a separate company, under the name of Ajax Electric Furnace Corporation, has been incorporated and organized for the purpose of carrying on the activities in the line of submerged resistor induction electric furnaces.

▼ ▼ ▼

Radio Sets Smaller, but Volume Increasing

THE radio industry sold a total of 3,706,900 receiving sets in 1930—only half a million, or 14 per cent, less than the year before. But its 1930 dollar volume in set sales dropped from $525,000,000 in 1929 to $302,529,500 in 1930, a reduction of 45 per cent. Tube sales fell off 25 per cent. Taking all products, the industry as a whole sold a grand total of $500,951,500 in 1930, as compared with $842,548,000 in 1929, a reduction of about 40 per cent, according to *Radio Retailing*.

Meanwhile average prices of radio sets have decreased sharply. Whereas the average radio set sold in 1928 for $115 and in 1929 for $110, the 1930 average set price was only $81.50, reflecting the influence of the 1,130,400 midgets which made up 45 per cent of the 1930 set volume. This ratio of midgets to large sets is growing, and based on the demands now observed midget sets may make up 75 per cent of 1931 volume.

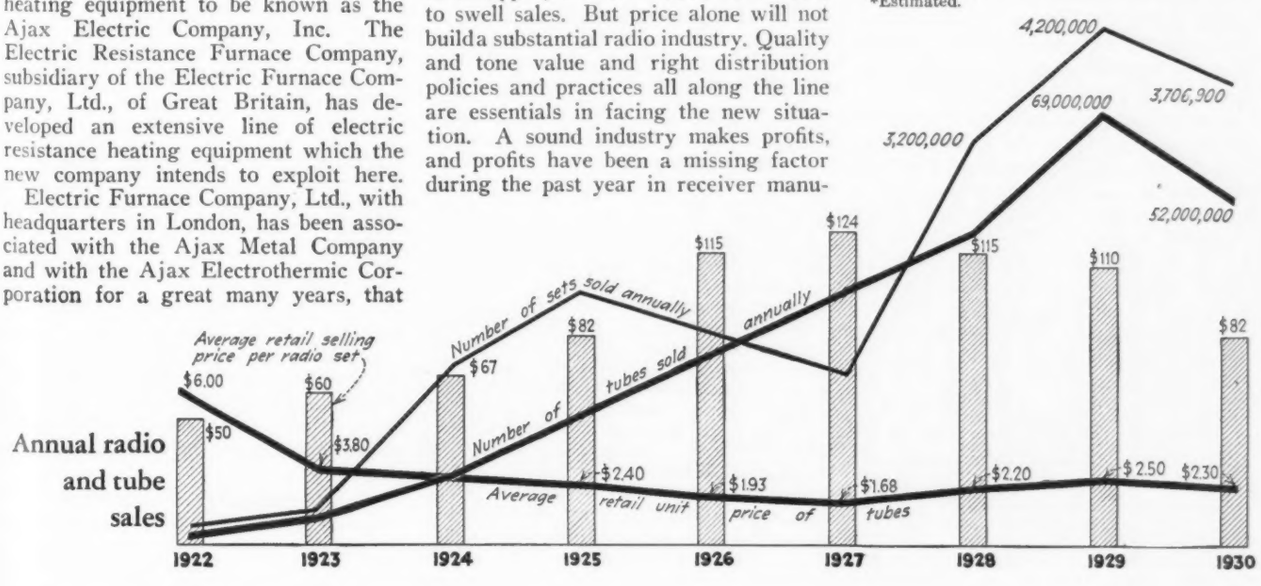
A new price level for radio sets has been topped, and this should be utilized to swell sales. But price alone will not build a substantial radio industry. Quality and tone value and right distribution policies and practices all along the line are essentials in facing the new situation. A sound industry makes profits, and profits have been a missing factor during the past year in receiver manufacture. Indeed, so far as our editors can determine, not a single radio manufacturer (except those having other lines of operation besides radio) made any profit during 1930. This is the deplorable but insistent fact.

Radio today stands at the crossroads. The trends and developments of the next ten months will indicate the future.

Retail Radio Sales

Product	1929	1930
Consoles and midget receivers.	4,200,000	3,672,400
	$525,000,000	$298,010,000
Radio-phonograph combinations	238,000	155,400
	$67,068,000	$34,188,000
Tubes.	69,000,000	52,000,000
	$172,500,000	$119,600,000
Speakers (excluding those already in receivers).	800,000	
	$16,000,000	$3,500,000
A-B-C (dry) batteries.	$30,530,000	$21,514,000
A-B power units, storage batteries and chargers.	$14,350,000	$6,920,000
Other accessories.	$9,600,000	$6,700,000
Parts (not to manufacturers).	$7,500,000	*$6,000,000
Automobile - radio sets and combinations.	$592,068,000	$332,198,000
Parts.	7,500,000	6,000,000
Accessories (inc. tubes).	242,980,000	158,234,000
Total sales for year..	$842,548,000	$500,951,500

*Estimated.



Market Conditions

MEDIUM-SIZED jobs in large volume feature the week's business on the Pacific Coast. Power apparatus is moving in larger volume, although specialized. Larger apparatus and motor sales have declined from the recent high level. A fair volume of business with a definite upward trend is noted in the Southwestern district.

——CONTRACTS AWARDED FOR EQUIPMENT in the Eastern district are on a heavier and more substantial basis than was anticipated a few weeks ago. Government projects are adding a healthy impetus.

▼ ▼ ▼

EASTERN

—ELECTRICAL EQUIPMENT *is striving hard to develop a lively step in the New York market and is succeeding far better than anticipated a few weeks ago. Contract awards, the actual pulse of conditions, are now on a heavier and more substantial basis than at any time since the first of the year.*

—WITH THE OFFICIAL OPENING *of the spring season at hand, the customary impulse is being given to incoming inquiries, and these are showing a better stride both for central station and industrial accounts. Other lines are holding up well, including marine business and electric traction. Government projects are giving good impetus to the situation and the largest gross purchases of many months are due from that quarter.*

A central station in New Jersey has closed with a New York manufacturer for a $240,000 contract, divided into transformers, costing $180,000, and oil circuit breakers and accessories, totaling $60,000. Another power company in South Jersey has placed a cable order aggregating $40,000, with a New York maker. A Pacific Coast city has given an electric meter award to an Illinois manufacturer to an amount of $100,000, covering a quantity of units over a period of months. The Universal Motor Company, Oshkosh, Wis., has tendered a low bid to the Department of Commerce, Washington, for furnishing from 100 to 150 small 2½-kw. engine-generator units at $419 each. Westinghouse Electric & Manufacturing Company will furnish transformers and accessory equipment for an outdoor power substation at East Springfield, Mass., for the United Electric Light Company.

J. G. Brill Company has secured a contract for five gasoline-electric motor cars for Cuba destination, and one additional set of equipment for a similar car for the same railroad. A New York manufacturer of signaling and electric interlocking equipment has secured several important contracts from Eastern and Western railroads, insuring a higher rate of plant operations for a number of weeks to come. The General Electric Company has taken an important contract for marine equipment for four twin-screw express liners for the Panama Mail Steamship Company, totaling close to $1,735,000, and representing a record commitment for this account for some time past; each vessel will be propelled by two 6,000-hp. geared turbines, with electrified auxiliary apparatus from two 500-kw. generators. The liners are being built by the Federal Shipbuilding & Dry Dock Company.

Electric refrigerator account shows exceptional strength. A leading manufacturer is developing a March production schedule over 25 per cent in excess of February output, with indications for further advance in April; employment is being given to 7,500 workers at the plant.

CONSTRUCTION PROJECTS

Signal Supply Officer, United States Army, Signal Section, Army Base, Brooklyn, N. Y., will receive bids until March 31 for eighteen motor-generators (Circular 104); also, at same time, for 51,600 ft. of cable and 48 cable reels (Circular 105). Consolidated Gas Company, New York, has filed plans for a service and repair shop to cost $350,000, with equipment. Starrett Investing Company, New York, plans multi-story factory and industrial building at Newark, N. J., to cost over $5,000,000. United States Veterans' Hospital, Washington, D. C., is taking bids until April 14 for veterans' hospital at Canandaigua, N. Y., including refrigerating and ice-making plant, electric equipment and system, etc. Board of Freeholders, Hackensack, N. J., plans central power plant and administration building to cost about $1,200,000. Tarentum Steel Corporation, Tarentum, Pa., is arranging plans for new mill on local site to cost over $1,000,000, with equipment. Bureau of Yards and Docks, Navy Department, Washington, D. C., is asking bids (no closing date stated) for addition to assembly shop at naval torpedo station, Goat Island, Newport, R. I. (Specification 6437), it has been announced.

NEW ENGLAND

—DURING THE PAST WEEK *industrial equipment was in fair demand. Small motor sales were steady. One prominent manufacturer reports a good volume of orders for switch and control apparatus and another notes a steady demand for scheduled materials.*

Heavy equipment orders have not been substantial in the New England district during the past week. Electric heating furnaces are attracting interest. Recently an electric carburizing furnace was ordered for a southern New England machine tool manufacturer. Electric commercial refrigeration equipment orders recently reported include units aggregating 1,600 hp., of which 1,200 hp. in two units was placed last week. Increased activity among manufacturers of electrical equipment in this district reflects an encouraging trend during the coming season. One prominent manufacturer notes orders totaling 3,500 electric ranges for Middle West delivery. Another reports an increase in volume of electric clock sales as compared with last year.

CONSTRUCTION PROJECTS

Board of Education, Springfield, Mass., contemplates a vocational school at West Springfield to cost over $175,000. Holyoke Water Power Company, Holyoke, Mass., contemplates an addition to water power plant. Wilcox, Crittenden & Company, Middletown, Conn., has approved plans for power plant extensions at marine hardware plant.

❖

SOUTHEAST

—ACTIVITIES IN THE *electrical field of the Southeast were a bit more brisk last week than for several weeks past, both as regards orders and inquiries. Purchases of machinery by mills presage orders for motor equipment and the next several weeks should see better business in both industrial and central station lines.*

There were ordered for one of the largest power companies last week $21,000 worth of circuit breakers and arresters and twelve 48-kva. induction voltage regulators. One company's crossarm and creosoted pine pole orders last week aggregated $9,250. In connection with a large range campaign under way in Georgia an order was placed for $7,550 of range switches. Some other central-station orders were for $4,450 of bare and weatherproof copper wire, $2,650 worth of metering equipment and $1,800 worth of distribution transformers.

CONSTRUCTION PROJECTS

Pittsburgh Plate Glass Company, Pittsburgh, Pa., plans extensions and improvements in plant at Clarksburg, W. Va., to

cost close to $100,000. Livingston, Tenn., plans installation of engine-generator unit at municipal power plant. American Atlas Corporation, Port Wentworth, Ga., plans rayon mill to cost over $100,000. Dr. Pepper Bottling Company, Dallas, Tex., plans plant at Birmingham, Ala., to cost close to $80,000.

❖

PACIFIC COAST

—PRESENT-DAY ORDERING *largely consists of job material now being placed but long held in abeyance. Wiring and power apparatus staples are moving better, though still far below normal. Power apparatus business is good, though mostly specialized.*

—A FAVORABLE INDICATION *is the amount of medium-sized jobs, which are well scattered, with school, hospital and small theaters predominating.*

Ten schools, averaging $200,000 each, are being figured on this week in a 50-mile radius in central California. The outstanding news of the week covered a $45,000,000 award to a San Francisco associated group for the Boulder Dam construction. Of major importance, too, is the power construction scheduled, including a $17,000 order for General Electric switchgear equipment for Hollister; three 4,000-kva. General Electric transformers, valued at $25,000, for Oakland; $110,000 worth of substations for the Peninsula district near San Francisco, including the towns of Millsbrae, Los Gatos and Redwood City, plus a $250,000 estimate for changes and relocations around Redwood City and a $50,000 expenditure for poles and transformers near San Jose; a 120-kva. capacitor for correcting the power factor on a Northeast bay irrigation district; an inquiry for $15,000 worth of transformer network protectors for a San Francisco building; an order for $20,000 worth of Westinghouse transformers for Los Angeles, with potential business for $40,000 more; $13,000 worth of poles, sizes 40 to 60 ft., for Glendale; half a carload of trolley wire for San Francisco; 600 poles and 42 miles of light copper wire for an Imperial Valley telephone system, and large garages for power company fleets in several cities. Major industrial construction announced several excellent projects, such as the removal of the "Hotpoint" range plant from Chicago to Ontario, Calif., and a $3,500,000 copper milling and concentrating plant for San Bernardino County, which will be the first unit of a $15,000,000 installation.

Further decreases in sales of motors and apparatus in Seattle and the Puget Sound district were noted last week. Orders reported include one automatic reclosing 23-kv. oil circuit breaker for the Pacific Power & Light Company; about $2,000 worth of miscellaneous switchgear and 40 transformers, from 10 kw. down, to several central stations; 25 motors from 30 hp. down to dealers in eastern Washington orchard districts; ten from 25 hp. down to a sawmill and about twenty to miscellaneous sources, the latter ranging from 100 hp. down. Specifications were written by the city of Seattle for a 7,500 kv. transformer for South End substation and the city of Tacoma is considering opening bids for furnishing, installing and testing miscellaneous piping material in steam plant auxiliary No. 2. Tacoma is also taking bids until March 21 for one deep-well pump, motor and accessories.

CONSTRUCTION PROJECTS

Mexican Central Airways, Long Beach, Calif., plans aviation terminal to cost $150,000, with electric lighting system approximating $60,000. Tustin Hills Citrus Association, Tustin, Calif., will build precooling plant to cost $90,000. Navy Department, Washington, D. C., plans naval radio station at Astoria, Ore., to cost $50,000. Columbia River Power Company, Seattle, Wash., contemplates hydro-electric power plant near Stevenson, capacity about 30,000 hp., to cost over $2,000,000. Utah Power & Light Company, Salt Lake City, Utah, contemplates steam-operated electric power plant to cost over $500,000. Public Service Company of Colorado, Denver, Colo., plans addition to steam-operated power plant at Valmont, Colo., to cost over $1,000,000.

❖

SOUTHWEST

—CONDITIONS IN THE *electrical industry still have the favorable tone of the last few weeks. Industrials are buying apparatus for replacements and extensions in good volume and utilities are breaking into 1931 budgets for purchase of pole line materials.*

Orders placed by two of the large distributing companies for crossarms aggregated $50,000. One of the steam railway systems bought line construction hardware amounting to $25,000. A power company in southern Missouri ordered poles and hardware to cost $7,000. A contract was placed for "white-way" equipment totalling $1,500. An Oklahoma company contracted for switching equipment for an out-of-doors substation approximating $20,000. A contract was placed for electrical equipment on a large Mississippi dredge boat reaching $60,000; another contract was for a 1,000-hp. turbine with reduction gear for driving a centrifugal pump valued at $20,000.

CONSTRUCTION PROJECTS

National Air Transport, Inc., Chicago, Ill., plans hangar and other facilities at municipal airport, Kansas City, Mo., to cost $85,000. Marquette Cement Manufacturing Company, St. Louis, Mo., plans extensions and improvements in mill at Cape Girardeau, Mo., including power equipment, to cost over $125,000. Sun Ray Oil Company, Sunray, Tex., plans oil refining plant to cost $350,000. Central Power & Light Company, San Antonio, Tex., plans 66,000-volt transmission line from San Benito to Brownsville, Tex., and vicinity. Taylor Refining Company, Tyler, Tex., plans oil refining plant to cost $300,000.

❖

MIDDLE WEST

—VERY LITTLE CHANGE *in general business conditions is observed from week to week in the Middle West section. However, a feeling of confidence is returning and is manifested generally. The volume of business is holding up fairly well and the prospects for future business appear more promising.*

Major activities show an improvement of their positions, particularly in the automotive industry. Railroads are placing a considerable number of equipment orders for rolling stock and rails, while maintenance purchases have increased slightly. The various utility companies are proceeding normally, with about an even schedule of construction and extension work. A considerable amount of cable and apparatus is on inquiry at this time and the demand for equipment is slightly greater. Some of the interesting items placed this week include eighteen 600-amp., 15-kw., single-pole, single-throw, wheel-mounted, solenoid-operated oil circuit breakers, one system type storage battery to cost approximately $160,000, construction of substation, $35,000, and addition to present structure to cost $50,000.

Jobbers' sales are somewhat better. There has been a fair demand for most appliances, with a particularly good demand noted for electric clocks and percolators, one jobber placing a single order for percolators to cost $25,000.

CONSTRUCTION PROJECTS

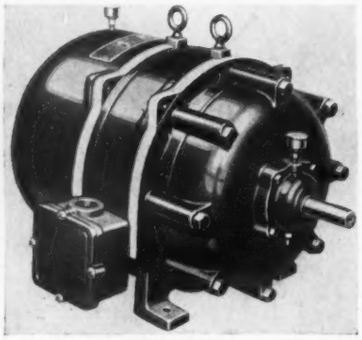
Ashland, Wis., plans airport lighting system. United States Engineer Office, Detroit, Mich., will receive bids until March 26 for six current transformers, three potential transformers and one three-element integrating watt-hour meter. (Circular 41). United States Lake Survey Office, Detroit, Mich., will receive bids until March 19 for one refrigerating plant (Circular 12). Consumers Power Company, Jackson, Mich., plans extensions and improvements in lines, substations, etc., at Bay City and vicinity, to cost $372,000, and for similar work in Owosso district, including new meter building, to cost $325,000. State School for Feeble-Minded, Grafton, N. D., is securing appropriation of $150,000 for power plant at institution. Grand Island, Neb., plans airport lighting system. Iowa Southern Utilities Company, Centerville, Iowa, plans extensions in transmission lines in Union, Adair and other counties.

New Equipment Available

Single or Polyphase Motor for Use in Gasoline Vapor

A MOTOR BUILT IN either polyphase or single-phase design with a totally inclosed frame or a totally inclosed fan-cooled frame has been announced by the Howell Electric Motor Company, Howell, Mich. The motor bears the approval of the Underwriters' Laboratories for class 1, group D. This classification covers use in gasoline vapor and air mixture or lacquer solvent and air mixture.

The polyphase motors are of squirrel-



cage construction with extra heavy castings, bolts and parts. All machined parts have large fitting surfaces to correspond with the Underwriters' Laboratories requirements for this class of service. The single-phase motors also are of squirrel-cage construction. These motors are of the condenser start type, each motor having a condenser starting unit placed in a separate box which must be mounted outside the hazardous area.

▼

Knife Switches Have Wide Margins for Overloads

A LINE OF SWITCHES known as type AL knife switches, designed to meet the latest requirements of the National Electrical Code and the National Board of Fire Underwriters, is announced by the Westinghouse Electric & Manufacturing Company.

The knife switches should be so selected that the rated capacity is at least equal to the combined one-hour overload rating of the connected load. Capacities range from 30 to 6,000 amp. inclusive, rear connected, and 30 to 600 amp. inclusive, front connected. The switches are made fusible and non-fusible plain and quick-break, for 250 volts d.c., 500 volts a.c. and 600 volts d.c. and a.c. Fusible switches above the 600-amp. sizes may be furnished, but should be made the subject of negotiation. All fusible switches are made fusible at the hinge end and single-throw only.

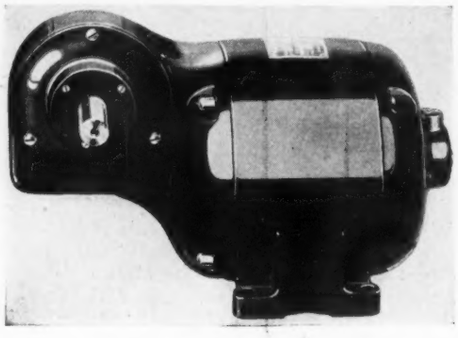
The d.c. and a.c. ratings are the same for switches up to and including 800 amp. The comparative ratings for switches above 800 amp. are shown in the following: Direct current, 1,200, 1,600, 2,000, 3,000, 4,000 and 6,000; 25 cycles, 1,100, 1,400, 1,800, 2,500, 3,400 and 4,400; also, 60 cycles, 1,100, 1,200, 1,600, 2,200, 2,800 and 4,000.

Some of the distinctive features are: Blade stops on break jaw that cannot interfere with proper contacting; jaws securely pinned and sweated into the jaw block; designed with a liberal margin for overloads, etc.

▼

Right-Angle Shaft-Type Geared-Head Motor

A NEW MASTER GEARED-HEAD motor of right-angle shaft type, built in sizes from 1/30 to 10 hp., polyphase, with interchangeable frames for the same horsepower and speed in different types of current, has been announced by the Master Electric Company, Dayton, Ohio. Standard ratios on which prompt delivery is obtainable are 8:1, 12:1, 18:1, 24:1, 30:1, 36:1, 48:1, 60:1 and 72:1. Practically any ratio between minimum and maximum can be obtained

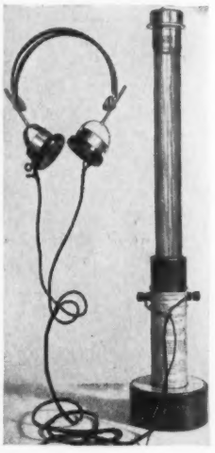


at an increase in price and extended delivery.

The motors are equipped with anti-friction bearings throughout, with precision ball bearings on the motor shaft and selected roller bearings on the slow-speed shaft. This construction permits of mounting in any position without change in construction.

Device Locates Hidden Ducts and Outlets

A DEVICE BY WHICH DUCTS and outlets under the floor can be speedily and accurately located, called the "Nepcoduct Divinator," has been announced by the National Electric Products Corporation, Pittsburgh. The divinator is employed where existing outlets are hidden by linoleum or other floor covering or buried in concrete. The ear readily recognizes the characteristic sounds made by the mechanism as the instrument is carried along the floor. When the divinator crosses "Nepcoduct," a definite sound is transmitted to the headset and when the instrument is over an outlet, another definite sound is made.



▼

Anchor Combines Cone and Expanding Types

A "GROUNDLOCK" ANCHOR, a new type which combines the principles of both the cone and the expanding types of anchor and is claimed to be superior to either in respect to holding power and creepage, has been announced by the Illinois Solderless Connector Company, Chicago. The anchor has a cone of heavy steel plate cut into six formed segments. These segments fold compactly to permit the cone to be placed in a small hole. A cast-iron spreader is used to expand the cone. The anchor is expanded by turning the rod until a spacer prevents further turning. When the anchor is fully expanded 45 per cent of the cone is out in solid earth. As tension is applied to the anchor the whole cone transmits the force outward at an angle perpendicular to the surface. The upper portion of the cone forces the fill out against the sides of the hole and the lower portion transmits the force directly into the solid ground surrounding it.

It is claimed that the anchor is very easy to install and that no special tools are required in order to prepare it for operation.